

CS11/H2
(DH11/DM11 COMPATIBLE)
COMMUNICATIONS MULTIPLEXER
TECHNICAL MANUAL



EMULEX

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TABLE OF CONTENTS

Section 1	INTRODUCTION	
1.1	SCOPE	1-1
1.2	OVERVIEW	1-1
1.2.1	General Description	1-1
1.3	FEATURES	1-1
1.3.1	Microprocessor Design	1-1
1.3.2	Packaging	1-2
1.3.3	Configuration Flexibility	1-2
1.3.4	Self-Test	1-2
1.4	FUNCTIONAL COMPATIBILITY	1-2
1.4.1	Diagnostics	1-2
1.4.2	Operating Systems	1-3
Section 2	GENERAL DESCRIPTION	
2.1	ORGANIZATION	2-1
2.1.1	Controller	2-1
2.1.2	Distribution Panel	2-1
2.2	PHYSICAL DESCRIPTION	2-2
2.2.1	Controller	2-2
2.2.1.1	Connectors	2-2
2.2.1.2	Indicator	2-2
2.2.1.3	Switches	2-2
2.2.1.4	PROMs	2-4
2.2.1.5	RAM Buffer	2-4
2.2.2	Distribution Panel	2-4
2.2.2.1	Line Adapter Boards	2-4
2.2.2.2	Interface Board	2-4
2.3	INTERFACES	2-6
2.3.1	Unibus	2-6
2.3.1.1	Unibus Starting Addresses	2-6
2.3.1.2	Interrupt Vector Addresses	2-6
2.3.1.3	BR (Interrupt) Priority Level	2-6
2.3.1.4	DCLO and INIT Signals	2-8
2.3.1.5	DMA Transfers	2-8
2.3.2	CALL/H and CALL/A Line Adapter	2-8
2.3.2.1	CALL/H and CALL/A Line Adapter Options	2-8
2.3.3	CALL/C Line Adapter	2-9
2.3.3.1	CALL/C Line Adapter Options	2-9
2.3.4	CALL/V Line Adapter	2-9
2.3.4.1	CALL/V Line Adapter Options	2-10
2.4	FUNCTIONAL DESCRIPTION	2-10
2.4.1	Receiver Operation	2-10
2.4.1.1	UART	2-10
2.4.1.2	Receiver Scanner	2-10
2.4.1.3	Silo Operation	2-11
2.4.1.4	Half-Duplex Operation	2-11
2.4.1.5	Received Character Distortion	2-11
2.4.2	Transmitter Operation	2-12
2.4.2.1	UART	2-12
2.4.2.2	DMA Transmission	2-12
2.4.2.3	Auto-Echo Operation	2-12

2.4.3	Modem Control	2-13
2.5	GENERAL PROGRAMMING INFORMATION	2-13
2.5.1	Initialize	2-13
2.5.2	Interrupts	2-14
Section 3	CONTROLLER REGISTERS	
3.1	DH11 Registers	3-1
3.1.1	System Control Register (SCR)	3-1
3.1.2	Received Character Register (RCR)	3-3
3.1.3	Line Parameter Register (LPR)	3-4
3.1.4	Current Address Register (CAR)	3-5
3.1.5	Byte Count Register (BCR)	3-6
3.1.6	Buffer Active Register (BAR)	3-6
3.1.7	Break Control Register (BCR)	3-7
3.1.8	Silo Status Register (SSR)	3-7
3.2	DM11 (MODEM CONTROL) REGISTERS	3-8
3.2.1	Control and Status Register (CSR)	3-8
3.2.2	Line Status Register (LSR)	3-10
Section 4	INSTALLATION	
4.1	INSPECTION	4-1
4.2	PREPARE THE CPU	4-1
4.3	CONTROLLER BOARD SETUP	4-2
4.3.1	Number of DH11 Emulations	4-2
4.3.2	Unibus Starting Address	4-2
4.3.2.1	Alternate Unibus Starting Addresses	4-6
4.3.3	Interrupt Vector Address	4-7
4.3.3.1	DH11 Vector	4-7
4.3.3.2	DM11 Vector	4-7
4.3.3.3	Interleaving DH11 and DM11 Vector Addresses	4-7
4.3.4	Force Two Stop Bits Option	4-8
4.3.5	CCL1 Run/Halt/Reset Switch	4-8
4.3.6	Jumpers	4-9
4.3.6.1	Expanded Silo Option	4-9
4.4	CP11 DISTRIBUTION PANEL CONFIGURATION	4-9
4.4.1	Panel Numbering	4-9
4.4.2	International Power Supply Conversion Instructions	4-9
4.5	CP11 INTERFACE BOARD SETUP	4-11
4.5.1	Interface Board Option Switches	4-11
4.5.1.1	CTS Flow Control	4-13
4.5.1.2	Force DTR/RTS Active	4-13
4.5.1.3	Sampling Rate for CALL/V	4-14
4.6	LINE ADAPTER CONFIGURATION/INSTALLATION	4-14
4.6.1	Option Selection	4-15
4.6.2	CALL/H Option Selection	4-18
4.6.2.1	Compatibility Mode Selection	4-18
4.6.2.2	Pinning Assignment Options	4-18
4.6.2.3	Line Test Switch	4-21

4.6.3	CALL/C Option Selection	4-21
4.6.3.1	Configuration for Active/Passive	4-21
4.6.3.2	Line Test Switch	4-21
4.6.4	CALL/V Option Selection	4-23
4.6.4.1	Compatibility Mode Selection	4-23
4.6.4.2	Pinning Assignment Options	4-23
4.6.4.3	Line Test Switch	4-23
4.6.5	CALL/A Option Selection	4-23
4.6.5.1	Compatibility Mode Selection	4-23
4.6.5.2	Pinning Assignment Options	4-25
4.6.5.3	Line Test Switch	4-25
4.7	CP11 DISTRIBUTION PANEL INSTALLATION	4-25
4.8	CC11 CONTROLLER INSTALLATION	4-25
4.8.1	SPC Slot Selection	4-25
4.8.2	NFG Signal Jumper	4-26
4.8.3	Controller Mounting	4-26
4.9	CABLING	4-26
4.9.1	Controller to Distribution Panel	4-26
4.9.2	CALL/H Line Adapter to External Device	4-26
4.9.2.1	Cable Types	4-28
4.9.2.2	Cable Lengths	4-29
4.9.3	CALL/C Line Adapter to External	4-29
4.9.3.1	Cable Type	4-29
4.9.3.2	Cable Length	4-30
4.10	VERIFICATION	4-31
4.10.1	Self-Test	4-31
4.10.2	Register Examination	4-31
4.10.3	Line Adapter Wrap-Around Test	4-31
4.10.3.1	CALL/H Tests	4-32
4.10.3.2	CALL/C Tests	4-33
4.10.4	Mini-Test	4-34
4.10.5	Diagnostics	4-35
4.10.6	Test Connector	4-35

Appendix A	ZDHM DIAGNOSTIC
Appendix B	EXPANDED SILO OPTION
Appendix C	ECS11 DIAGNOSTIC
Appendix D	DECX11 SYSTEM EXERCISER DIAGNOSTIC

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	
Table 1-1	CS11/H2 Subsystem Specifications	1-4
Table 2-1	DH11 and DM11 Unibus Starting Addresses	2-6
Table 2-2	SPC Unibus Connections	2-7
Table 2-3	CALL/H and CALL/A Interface Connector	2-8
Table 2-4	CALL/V Interface Connector	2-9
Table 3-1	Tx and Rx Speed Table	3-4
Table 4-1	Number of DH11 Emualtions (CP11 Distribution Panels)	4-2
Table 4-2	CC11 Factory Switch Settings	4-3
Table 4-3	Unibus Starting Address Selection	4-3
Table 4-4	DH11 Vector Address Selection	4-3
Table 4-5	DM11 Vector Address Selection	4-5
Table 4-6	Jumper Definitions	4-9
Table 4-7	CP11 Interface Board Switch Functions	4-12
Table 4-8	CALL Line Adapter Models	4-15
Table 4-9	Jumper Connections for CALL/H, CALL/V, and CALL/A	4-20
Table 4-10	Pinning Options for CALL/H, CALL/V, and CALL/A	4-20
Table 4-10	CALL/C Line Adapter Options	4-21
Table 4-11	RS-232-C Cable Lengths	4-29
Table 4-12	20 mA Current Loop Cable Lengths	4-30

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	
Figure 2-1	CS11/H2 Block Diagram	2-3
Figure 2-2	CC11 Controller Board and CP11 Distribution Panel	2-5
Figure 4-1	CC11 Controller	4-5
Figure 4-2	CP11 Distribution Panel Physical Dimensions	4-10
Figure 4-3	CP11 Interface Board Switch Positions	4-11
Figure 4-4	CALL/H Line Adapter	4-16
Figure 4-5	CALL/C Line Adapter	4-17
Figure 4-6	CALL/V Line Adapter	4-17
Figure 4-7	CALL/A Line Adapter	4-18
Figure 4-8	CALL/H Channel Schematic	4-19
Figure 4-9	CALL/C Channel Schematic	4-22
Figure 4-10	CALL/A and CALL/V Channel Schematic	4-24
Figure 4-11	Terminal Cable Schematic	4-27
Figure 4-12	Modem Cable Schematic	4-27
Figure 4-13	Null-Modem Cable Schematic	4-28

1.1 SCOPE

This manual provides information related to the capabilities, design, installation, and use of the CS11/H2 communications multiplexer. In addition, this manual provides diagnostics and application information.

1.2 OVERVIEW

1.2.1 General Description

The CS11/H2 Communications Multiplexer connects up to 64 asynchronous serial communication lines with individually programmable parameters to the PDP-11 or VAX-11 computers manufactured by Digital Equipment Corporation.

The CS11/H2 emulates 1, 2, 3 or 4 DEC DH11 Asynchronous 16-Line Multiplexers and their associated DM11 Modem Control units. The subsystem consists of a CC11/H controller board and 1 to 4 CP11 Distribution Panels, each containing one or two CA11 line adapter boards. The CC11 is a single hex-size board which plugs directly into the PDP-11 or expansion chassis. The line adapter boards contain the line connection and the line circuitry which interface the serial communication line with the parallel data cable to the communications controller.

The CS11/H2 includes the functions of the DM11 Modem Control unit as part of its emulation. As such the CS11/H2 serves as an interface between the modem and the processor. The CC11/H controller board handles the DM11 emulation as a standard feature. The modem control signals are available as a standard feature with the RS-232-C line adapter (CA11/H); however, the current loop line adapter (CA11/C) does not support modem control.

1.3 FEATURES

1.3.1 Microprocessor Design

The CS11/H2 design incorporates an 8-bit high performance bipolar microprocessor to perform all controller functions. The microprocessor approach provides for a reduced component count, high reliability, easy maintainability, and most importantly the ability to perform an emulation of the equivalent DEC controller. The Emulex controllers achieve functional capability beyond that of the DEC controllers which they emulate, by providing enhancement features such as built-in self-test during power-up and line-loop test.

1.3.2 Packaging

The CC11/H controller is constructed on a single hex-size PC board which plugs directly into the PDP-11 chassis or an expansion chassis. A single 34-pin flat cable daisy-chains to a maximum of four CP11 distribution panels which contain the line adapter circuitry. The CA11 line adapter boards are plugable modules in eight line groups.

1.3.3 Configuration Flexibility

Each communications controller emulates up to four 16 line DH11s and four DM11s for a maximum of 64 lines. Various types of line adapters may be mixed in eight line groups.

1.3.4 Self-Test

The controller incorporates an internal self-test routine which is executed upon power-up. This test exercises all parts of the microprocessor, the on-board memory, and the individual line adapters. Although this test does not completely test all circuitry, successful execution indicates a very high probability that the controller and the line adapters are operational. If the controller fails the self-test, it leaves the fault LED ON and the controller cannot be addressed from the CPU.

The power-up self-test also does a loop test on each of the line adapter UART circuits. In addition it is possible to perform either an internal or external loop-back test on groups of eight circuits while the CS11/H2 is online.

1.4 FUNCTIONAL COMPATIBILITY

1.4.1 Diagnostics

The CS11/H2 executes the following standard DEC DH11 and DM11 diagnostics (*16 lines only):

ZDHA	DH11 Static Logic Test
ZDHB	DH11 Memory Test
ZDHC	DH11 Transmitter and Receiver Basic Logic Test
ZDHD	DH11 Speed Selection Logic Test
ZDHE	DH11 Character Length and Basic Data Test
ZDHF	DH11 Single Line Data Test
ZDHH	DH11 Auto-Echo Test
ZDHI	DH11 Break and Half-Duplex Test
ZDHJ	DH11 Echo Test
ZDHK	DH11 Modem Control Multiplexer Diagnostic*
ZDHM	DH11 Comprehensive Diagnostic
ZDHN	DH11 Data Reliability Test

1.4.2 Operating Systems

The CS11/H2 communications multiplexer is compatible with all DEC PDP-11 operating systems without modification.

Table 1-1
CS11/H2 Subsystem Specifications

Characteristic	Specification
CC11/H CONTROLLER	
Design	High-speed bipolar microprocessor implementation of all CS11 functional operations.
Function	Provides complete functional emulation of up to four DH11 multiplexers and DM11 modem controls.
Software Compatibility	Diagnostics: ZJ179 (DH11) and ZJ118 (DM11) kits Operating Systems: RSX11M, RSX11M+, RSTS/E
No. of Distribution Panels	1 to 4
No. of Lines	8 to 64
Throughput	50,000 characters per second total
Distribution Panel Interface	Eight-bit bidirectional data bus with necessary addressing and control in a single 34-conductor flat cable.
Receive Silo	64-character FIFO buffer for each functional 16-channel DH11; Interrupt programmable for any FIFO buffer full level.
Expanded Receive Silo	Optional 128-character FIFO buffer for each functional 16-channel DH11.
CPU Interface	Standard Unibus SPC interface. One bus load for both DH11 and DM11.
DMA Address Range	0 - 128K words
DMA Transfer	16-bit word with parity check

Table 1-1 (Cont.)
CS11/H2 Subsystem Specifications

Device Address	Selectable with switches and PROMs to cover all DEC-defined DH11 assignments.
Vector Address	Switch selectable for DM11 and DH11
Priority Level	BR5 for DH11 BR4 for DM11
Indicator	Controller self-test fault
Option Switches	DIP switches for selection of controller options.
Packaging	Single hex-size two layer printed circuit board
Power	5v +/- 5%, 4 amps.

CP11 DISTRIBUTION PANEL

Configuration	Seven inch high panel for two 8-channel line adapters, including power supply and cable interface.
Dimensions	7" high x 19" wide x 7" deep
Weight	16 lbs.
Power	Self-contained supply, 50-60 Hz. 115/230 vac, 35 watts

Table 1-1 (Cont.)
CS11/H2 Subsystem Specifications

CALL/H, CALL/A, and CALL/V LINE ADAPTER

Configuration	Two-sided PCB measuring 6-1/2" x 8" which plugs into CP11 Distribution Panel.
Interface	RS-232-C, with DEC DM11-compatible modem control.
Connectors	Standard EIA RS-232-C, 25-pin male connector.
Indicators	Fault LED per line.
Transmission Modes	Half-duplex, full-duplex, echo-plex
Line Formats	Character lengths: 5-8 bits Stop bits: 1, 1-1/2, 2 Parity: odd, even, none
Data Rates	50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200. (External 1x or 16x clock available on CALL/V.)
Distortion	Transmitter: less than 2% intersymbol Receiver: up to 43% intersymbol distortion and speed variation
Modem Control Signals	To: RTS, DTR, Secondary Tx From: CTS, CD, RI (or DSR), Secondary Rx

CALL/C LINE ADAPTER

Configuration	Same as CALL/H.
Interface	20 mA current loop.
Connections	Four screw posts
Transmission Modes	Half-duplex, full-duplex, echo-plex
Line Formats	Same as CP11/A.
Data Rates	Same as CP11/A.
Distortion	Same as CP11/A.

2.1 ORGANIZATION

The CS11/H2 communications multiplexer consists of two units: the CC11/H Communications Controller and one to four CP11 Distribution Panels which are connected to the controller by a single 34-conductor flat cable.

2.1.1 Controller

A block diagram showing the major functional elements of the CC11 controller is shown in Figure 2-1. The controller is organized around an 8-bit high-speed bipolar microprocessor which performs all controller functions. The ALU and register file portion of the microprocessor are implemented with two 2901 bit slice components. The microinstruction is 48 bits in length and the control memory of 1K words is implemented with 12 2K X 4 PROMs.

A 1K x 8 high-speed RAM, which is optionally increased to 2K X 8 for 32 or 64 lines, holds device registers, silo buffer and working storage for the microprocessor. The RAM is both a source and destination to the internal data bus and is addressed directly and indirectly by the microprocessor.

The Unibus interface consists of a 16-bit bidirectional set of data lines and an 18-bit set of address lines. The Unibus interface is used for programmed I/O, CPU interrupts and NPR data transfers. The microprocessor responds to all programmed I/O and carries out the I/O functions required for the addressed controller register. The microprocessor also controls all NPR read operations and transfers data between the Unibus data lines and the distribution panels.

The line adapter boards with their UART circuits are interfaced to the controller by a 34-conductor cable. This cable contains an 8-bit bidirectional data path, seven address signals and control signals. The Output Data Register holds data going to the line adapters. The Line Address Register holds the address of the line and the distribution panel.

2.1.2 Distribution Panel

Each distribution panel contains one or two eight-line CALL Line Adapters and an integral power supply. Four types of line adapters are available. The CALL/H and the CALL/A provide an RS-232-C interface with modem control. The CALL/V provides an RS-232-C interface with modem control and is synchronous or asynchronous. The CALL/C has a 20 mA current loop interface and does not support modem control. The line adapters provide the data and modem interface circuitry plus the UART circuits which provide the serial to parallel and parallel to serial conversions normally found in

these type devices. The UART also contains the baud rate generator for each line. Data control and status transfers between the line adapters and communications controller are on a parallel byte basis.

2.2 PHYSICAL DESCRIPTION

2.2.1 Controller

The CCl1 controller board is designated Part Number CU1110401. The board is shown in Figure 2-2. The board dimensions correspond to the DEC hex-size board. The board is two-sided and contains extractors which interface mechanically with the chassis box into which the controller is to be placed.

2.2.1.1 Connectors

The distribution panels interface to the controller by means of the 34 pin connector J1 located in the upper right hand corner of the board. Connectors J2 and J3 are used for connecting special test equipment for factory test and repair operations and are not intended for use in normal controller operations.

2.2.1.2 Indicator

The LED located on the top of the board is a fault indicator which will remain ON after powering-up the controller if a fault is detected during the self-test.

2.2.1.3 Switches

There are three DIP switches on the board. In addition there is a four pole switch (SW3) located along the top edge of the board. The use of these four switches is as follows:

- SW1 Controller options
- SW2 DH11 and DM11 interrupt vector address selection
- SW3 Number of DH11/DM11 emulations (No. of panels)
 Controller Reset
 Power-up line test fail override
- SW4 DH11/DM11 Unibus starting address selection

Section 4 contains switch settings for these option switches.

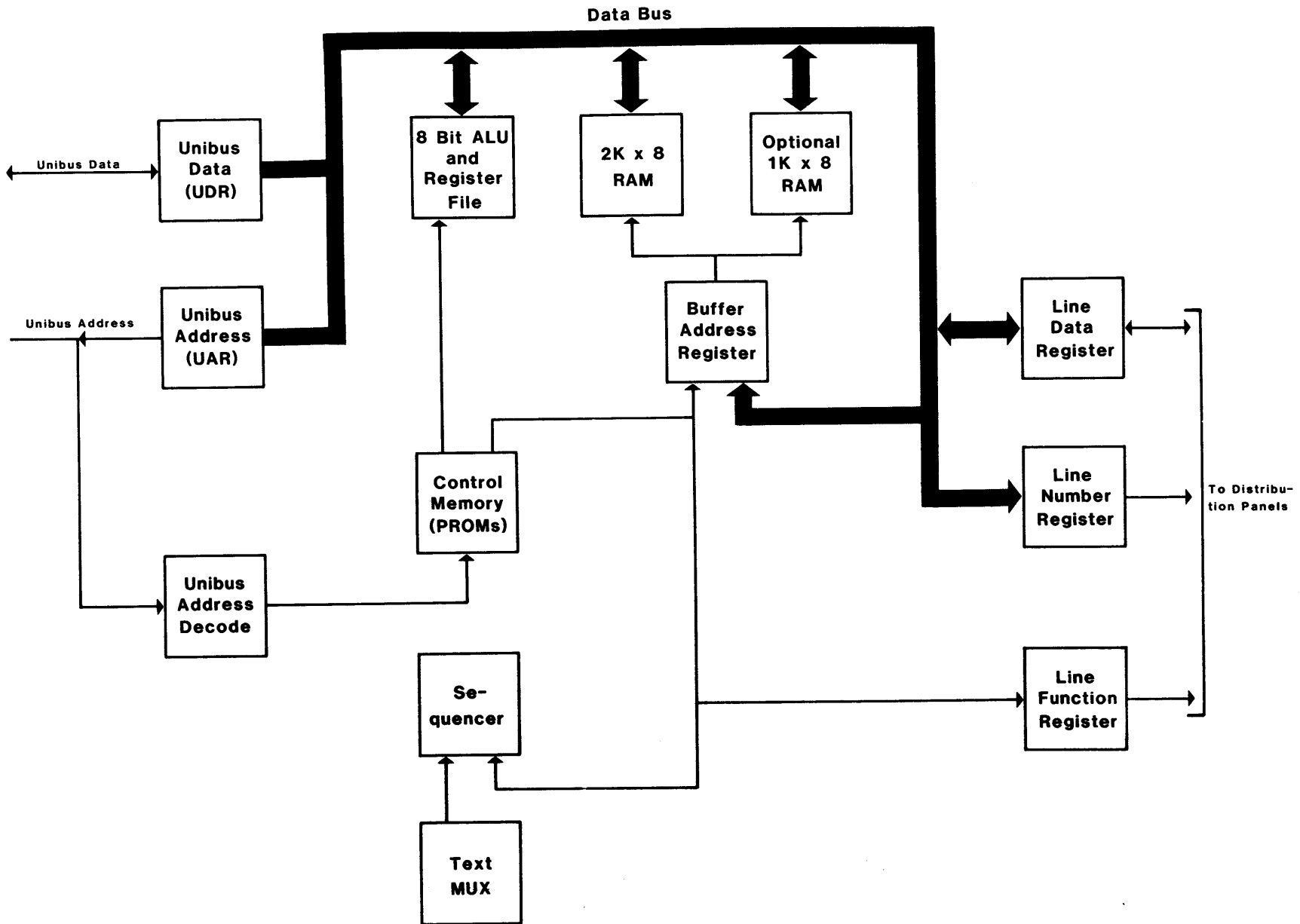


Figure 2-1 CS11 Block Diagram

2.2.1.4 PROMs

The 12 firmware emulation PROMs are located along the top edge of the board. The PROM locations are designated 0 through 11. The number written on top of the PROM IC is the Emulex part number which identifies the unique pattern and revision level of the PROM. These numbers are in the same numerical order as that of the PROM numbers.

The controller makes use of two special PROMs located at U59A and U59B to perform Unibus address decoding.

2.2.1.5 RAM Buffer

The two 2148 RAM ICs located at U38 and U39 are used for configurations up to 32 lines. RAM ICs are added at U40 and U41 for configurations of 40 to 64 lines. Additional RAM is placed at U21 and U22 for the optional extended FIFO buffer.

2.2.2 Distribution Panel

The distribution panels consist of a mechanical assembly, a power supply, an interface board, and one or two line adapter boards with their cover plates. The distribution panel with two CALL Adapter Panels installed is shown in Figure 2-2.

2.2.2.1 Line Adapter Boards

The line adapter boards measure 6-1/2" x 8" and connect to the interface board, located in the back of the panel, through a set of 38 AMP MOD 1 pins. The CALL/H, CALL/A, and CALL/V boards contain eight 25-pin male connectors for interfacing to RS-232-C terminals, modems, or like devices. The CALL/C also provides eight lines, but it uses a four-screw terminal strip for interface to 20 mA current loop devices. Both contain UART and level conversion circuitry for each line.

Each line has a small LED indicator mounted directly above the connector which is used to indicate that the internal self-test of the controller has detected a fault for that line adapter. A three position slide switch in the upper left hand corner of the line adapter board is used to enable an internal or external wrap-around test for the eight line group.

2.2.2.2 Interface Board

The interface board interfaces the daisy-chain cable and the power supply to the two line adapter boards. Each of the line adapter boards plugs into the AMP pins connected to the interface board and in turn is fastened to the panel by four screws. Two daisy-chain cable connectors protrude through the back of the panel so that the cable may be continued or terminated if the panel is the last one on the cable. The power supply cable plugs into a connector on the back of the interface board which also protrudes through the panel.

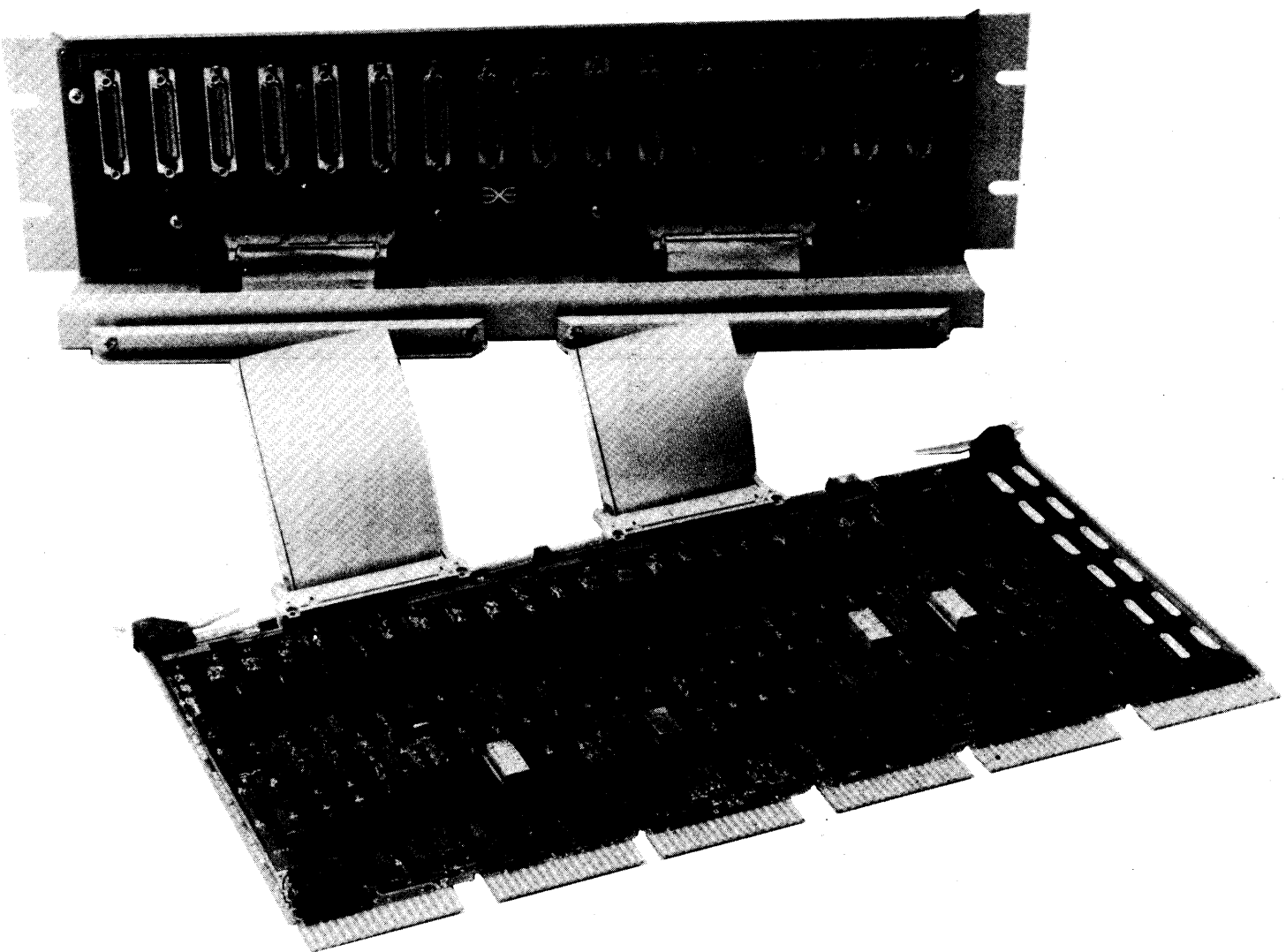


Figure 2-2
CCL1 Controller Board and Distribution Panel

There are four switchpacks on the interface board that can be used to select a variety of options. They are described in section 4.5. Table 4-7 contains switch settings for these option switches.

2.3 INTERFACES

2.3.1 Unibus

The controller interfaces to the PDP-11 or VAX-11 Unibus via a Small Peripheral Controller (SPC) connector. The Unibus consists of 18 address lines and 16 bi-directional data lines, plus control signals for data and interrupt vector address transfer and for becoming bus master. The signal connections of the controller to the Unibus are shown in Table 2-2.

2.3.1.1 Unibus Starting Addresses

The Unibus starting address for the first DH11 and DM11 is selected by SW4. The available addresses are listed in Table 2-1, below. Instructions for setting SW4 are given in paragraph 4.3.2.

Table 2-1
DH11 and DM11 Unibus Starting Addresses

DH11	DM11
760020	770500
760040	770510
760060	770520
760100	770530
760120	770540
760140	770550
760160	770560
760200	770570
760220	770600
760240	770610
760260	770620
760300	770630

2.3.1.2 Interrupt Vector Addresses

The DM11 and DH11 interrupt vector addresses are programmed by SW2. Data for setting these switches is given in Table 4-3 and Table 4-4.

2.3.1.3 BR (Interrupt) Priority Level

The single DM11 interrupt is on level BR4. The two DH11 interrupts are on BR5.

Table 2-2
SPC Unibus Connections

Column	C		D		E		F		
	Pin	1	2	1	2	1	2	1	2
A	NPGIN	+5V		+5V		+5V		+5V	
B	NPGOUT					-15V		-15V	
C	PA	GND		GND	A12	GND		GND	
D		D15		BR7	A17	A15	BBSY		
E		D14		BR6	MSYN	A16			
F		D13		BR5	A02	C1			
H	D11	D12		BR4	A01	A00			
J		D10			SSYN	C0	NPR		
K		D09		BG7 IN	A14	A13			
L		D08	INIT	BG7 OUT	A11				
M		D07		BG6 IN			INTR		
N	DCL0	D04		BG6 OUT	A08				
P		D05		BG5 IN	A10	A07			
R		D01		BG5 OUT	A09				
S	PB	D00		BG4 IN					
T	GND	D03	GND	BG4 OUT	GND		GND	SACK	
U		D02			A06	A04			
V	ACLO	D06			A05	A03			

2.3.1.4 DCL0 and INIT Signals

The DCL0 or INIT signals perform a controller clear. The self-test is performed only if DCL0 has been asserted.

2.3.1.5 DMA Transfers

The controller performs word DMA transfer read operations, so as to halve Unibus loading. The controller checks for memory parity errors (if the system has a memory parity controller) which is posted as an NXM error when a parity error is detected.

2.3.2 CALL/H and CALL/A Line Adapters

The CALL/H and CALL/A Line Adapters have eight channel interfaces. Interface pinning assignments are the same as the DEC DH11 with DM11 modem control. As such, the pinning assignments are those specified for Bell 202C Data Sets (modems). Electrical signal levels are per EIA RS-232-C specifications. The receiver circuits are implemented with 1489 devices; the transmitter circuits are implemented with 1488 devices. Stock Emulex interface pinning assignments are defined in Table 2-3.

Table 2-3
CALL/H and CALL/A Interface Connector

Pin #	Function
Pin 1	- Chassis Ground
Pin 2	- Transmit Data
Pin 3	- Receive Data
Pin 4	- Request To Send
Pin 5	- Clear To Send
Pin 7	- Logic Ground
Pin 8	- Carrier Detector
Pin 11	- Secondary Transmit Data
Pin 12	- Secondary Receive Data
Pin 20	- Data Terminal Ready
Pin 22	- Ring Indicator

2.3.2.1 CALL/H and CALL/A Line Adapter Options

The CALL/H and CALL/A interfaces can be reconfigured to allow use of a variety of modems. Instructions for implementing the options are in the chapter on installation, section 4.6. Note that the some modems may not be supported by DEC software and that custom drivers may have to be written for their implementation.

2.3.3 CALL/C Line Adapter

The CALL/C Line Adapter provides a 20 mA current loop interface for each of its eight lines. Modem control is not supported. Both the transmit and receive circuits are optically coupled. This provides common noise rejection that is much greater than either RS-232-C or 20 mA interfaces that are not optically coupled. LEDs above each channel's interface connector are used to indicate faulty channels.

2.3.3.1 CALL/C Line Adapter Options

There are several options that can be selected using jumpers on the CALL/C. The CALL/C comes from the factory configured with active transmitters and receivers. The transmitters and receivers can be independently reconfigured for passive operation if required. The CALL/C also comes configured from the factory with an open circuit voltage of 12VDC. A Long Line (L.L.) option with an open circuit voltage of 24VDC can be selected if longer line lengths and/or increased immunity to noise are required. To further increase noise rejection, additional filtering may be strapped to the receiver loop. Implementation of these options is described in the Installation Section, paragraph 4.6.3.

2.3.4 CALL/V Line Adapter

The CALL/V Line adapter has eight channel interfaces. The CALL/V can operate in either synchronous or asynchronous mode. Electrical signal levels are per EIA RS-232-C specifications. The receiver circuits are implemented with 1489 devices; the transmitter circuits are implemented with 1488 devices. Stock Emulex pinning assignments are shown in Table 2-4.

Table 2-4
CALL/V Interface Connector

Pin #	Function
Pin 1	- Chassis Ground
Pin 2	- Transmit Data
Pin 3	- Receive Data
Pin 4	- Request To Send
Pin 5	- Clear To Send
Pin 6	- Data Set Ready
Pin 7	- Logic Ground
Pin 8	- Carrier Detector
Pin 11	- Secondary Transmit Data
Pin 12	- Secondary Receive Data
Pin 15	- Transmit Clock
Pin 17	- Receive Clock
Pin 20	- Data Terminal Ready
Pin 22	- Ring Indicator
Pin 24	- Transmit Clock Out

2.3.4.1 CALL/V Line Adapter Options

The CALL/V can be reconfigured to allow the use of a variety of modems. The changes are made using wire wrap jumpers. Instructions for implementing the options are in the chapter on installation, paragraph 4.6.4

2.4 FUNCTIONAL DESCRIPTION

2.4.1 Receiver Operation

2.4.1.1 UART

Reception on each line is by means of universal asynchronous receiver/transmitters (UARTs). These MOS/LSI devices perform all the functions of double buffered asynchronous character assembly. The receiver section of the UART samples the line at 16 times the bit rate of the signals to be received on the line. Upon detection of a mark to space transition, the UART counts eight clock pulses and checks the state of the line again. This sampling occurs in the center of the normal start bit. If the sample is a mark, the receiver returns to its idling state, ready to detect another mark to space transition. If the sample is a space, the receiver enters the data entry condition and samples the state of the line at subsequent sample points spaced at multiples of 16 clocks from the center of the start bit. The number of samples taken is determined by the character length information and parity enable programmed in the Line Parameter Register. If parity checking is enabled for the line, the receiver computes the parity of the character received and compares it with the parity sense specified for the reception on the line. If the parity does not check, the parity error bit is set.

The character length, parity, and number of stop bits that are used by the UART to perform the above operations are stored in each UART from information received from the Line Parameter Register for the associated UART.

2.4.1.2 Receiver Scanner

The receiver section of the UARTs are serviced by a receiver scanner which polls the UARTs for a line which has assembled a received character. The received character and its associated status bits are transferred to the silo, if it is not full. The receiver scanner has priority over the transmitter scanner since the transmitting output is by means of DMA and can be deferred if necessary during conditions of peak activity. In this manner, characters will not be lost, or overrun conditions generated because of the operation of the controller itself.

2.4.1.3 Silo Operation

The silo for each DH11 is contained in the RAM memory. A 16-bit wide by 64 word (optional 128 word) deep first-in-first-out (FIFO) storage is maintained by the controller's microprogram. In effect, a 16-bit word entered at the top of the silo is automatically shifted down to the lowest location that does not already contain an entry. The bottom of the silo is the received character register.

There are two registers associated with the silo. The received character register is a read-once register that is the bottom location of the silo. Reading it extracts the character, and its associated status, from the silo and causes all other entries to shift down one word position.

The other register is the Silo Status Register. The high byte of this register is read-only and contains the status of the number of words which fill the silo. The low byte is read-write and contains the number of characters which must be loaded into the silo before a received interrupt request will be generated.

2.4.1.4 Half-Duplex Operation

When the line is programmed for half-duplex operation, the receiver is enabled at all times except when the BAR bit for the line is set indicating that transmission is under way. The receiver is blinded from receiving the characters being transmitted, since the transmitting is done on the same circuit as the receiving. No transmit characters are sent to the silo. The line may not be in auto-echo mode when operating half-duplex, since transmitting and receiving can not be done at the same time.

2.4.1.5 Received Character Distortion

Received characters may contain up to 43.75 percent distortion on any bit due to the sampling rate employed in the UART. However, the overall bit rate must be accurate. Specifically, errors in bit rate are accumulative such that when the receiver samples the first stop bit to see if it is a mark, the error accumulated by that time must not exceed 43.75 percent of the bit time. The accumulated error (called "gross start-stop distortion") is calculated as clock error times number of bits plus one, plus the bias distortion of the final character. Assuming the reception of eight data bits, or seven data bits plus parity, 4.8 percent speed distortion would be permissible. Speed distortion (clock error and bit rate error) of any amount causes severe problems to an echo situation. If a terminal sends at a slightly fast rate and the controller sends the exact same characters back to the terminal at the correct rate, the silo will eventually fill with unechoed characters.

2.4.2 Transmitter Operation

2.4.2.1 UART

Transmission on each line is also performed by UARTs. These MOS/LSI devices perform all the necessary functions for double buffered asynchronous character transmission. The transmitter section of the UART holds the serial output at a marking state when idle. When a character has been loaded into the transmitter holding buffer, the UART will generate a start bit within 1/16 of the bit time. The start space is followed by five, six, seven, or eight data bits and the parity bit if parity is selected. Control of the UART is performed by the Line Parameter Register. Data bits are presented to the line least significant bit first.

The minimal number of stop bits depends upon the setting in the Line Parameter Register. If transmission is in five-bit code, either one or one and half stop bits is transmitted.

If the transmitter's holding register has been loaded while a character is being transmitted, the second character will have its start bit transmitted immediately at the end of the preceding character's stop bits.

2.4.2.2 DMA Transmission

Unlike the receiver operation where the controller transfers received characters from the UART to the silo for programmed input by the CLU, the CS11/H2 performs automatic direct memory access (DMA) of characters to be transmitted. Data is accessed a word at a time from the PDP-11 memory except for odd bytes at the beginning or end of the buffer. The low-order byte is transferred to the UART's transmitter holding buffer and the high-order byte is held in the controller's memory. The DMA accessing is controlled by the 16-bit Byte Count Register (BCR) and the 18-bit Current Address Register (CAR). The CAR is incremented by two for every word accessed from memory. The BCR is incremented by one for each byte transferred to the UART's transmitter holding buffer. The transmitting operation for a line is active only as long as the bit corresponding to the line is set in the Buffer Active Register (BAR). This bit is set under programmed control to initiate the transmitting of a buffer and is reset after the last character of the buffer has been shifted from the UART.

2.4.2.3 Auto-Echo Operation

There are provisions for the controller to echo (transmit) received characters without software intervention. This feature is enabled for each line by setting the AEE (bit 15) in the Line Parameter Register.

The auto-echo is performed by the receiver scanner. When the receiver scanner finds a received character for a line on which the auto-echo is enabled and which does not have a framing error or

overflow error, it transfers the character to the transmitter holding register for the line as well as to the silo. If the transmitter holding register is not empty at the time the received character is found, the character remains in the receiver holding register until the next time the receiver scanner finds the character.

It is not advisable to simultaneously transmit messages on a line and auto-echo characters received on that line. The auto-echo feature of the controller will interlock these functions to some degree, but if more than two characters are received on a line while the scanner is waiting for the transmitter holding buffer to become available, data overrun occurs and characters are lost. Auto-echo and software driven transmission should not be attempted on the same line simultaneously if input from the line is expected.

2.4.3 Modem Control

The line interface board provides level conversion for all modem control lines. The output control functions are: Terminal Ready, Request To Send, and Secondary Transmit. The received control functions are: Clear To Send, Carrier, Secondary Receive and Ring.

The controller has a modem control scanner which scans the four modem control inputs line-by-line. When a transition is detected, the scanner is stopped with appropriate status displayed in the control status register (CSR), and an interrupt is generated. The scanner can be programmed to "free run" or can be sequentially stepped through line-by-line. The scanner may be cleared under program control to reset the scanner, its enable, and all memory associated with the transition detectors.

2.5 GENERAL PROGRAMMING INFORMATION

2.5.1 Initialize

The Unibus INIT signal clears the silo, UARTs and all registers except the Current Address and Byte Count Registers. All scanners are forced to line zero and all memory associated with transition detectors is cleared.

MC (SCR bit 11) performs an initialization of the DH11 portion of the controller. CS (CSR bit 11) provides a clear of the scanner and transition detector logic of the DM11 portion of the controller.

2.5.2 Interrupts

The following kinds of interrupts are generated by the controller:

Receiver Interrupt (SCR bit 07) - This interrupt, when enabled by RIE (SCR bit 06), occurs whenever the number of entries in the silo exceeds the silo alarm level that the program has stored in low-byte of the Silo Status Register.

Storage Overflow Interrupt (SCR bit 14) - This interrupt, when enabled by SIE (SCR bit 12), occurs when the receiver scanner wants to put a character into the silo which is already full with 64 entries. Should this situation occur, it does not necessarily mean that data has been lost since the character which was to have been moved to the silo is still in the UART's receiver holding register.

Transmitter Interrupt (SCR bit 15) - This interrupt, if enabled by TIE (SCR bit 13), occurs whenever a line has finished the transmission of a complete string of characters. Specifically, it occurs when the corresponding BAR bit is reset when the last character has left the shift register of the UART.

Non-Existent Memory Interrupt (SCR bit 10) - This interrupt, when enabled by TIE (SCR bit 13), occurs whenever the controller detects no response from the addressed memory or a parity error is detected in the word which is accessed.

Modem Transition Interrupt (CSR bit 07) - This interrupt, if enabled by IE (CSR bit 06), occurs whenever the modem control scanner detects a transition on a modem control input which is enabled.

3.1 DH11 REGISTERS

There are eight registers for the DH11. Three of these registers (LPR, CAR and BCR) are replicated for each of the 16 lines. Selection of the particular register set is made by the line number in SCR.

3.1.1 System Control Register (SCR) 760xx0

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
TI	SI	TIE	SIE	MC	NXM	MM	CNI	RI	RIE	A17	A16	Line No.			

Read/write, byte addressable.

Transmitter Interrupt (TI) - Bit 15

This bit is a read-write bit which is set whenever the controller increments the byte count to zero, indicating the loading of the last character of a buffer into a UART transmitter holding register. This bit, when set, causes an interrupt to be generated if TIE (bit 13) is set.

Storage Interrupt (SI) - Bit 14

This read-only bit is set whenever the receiver scanner has found a receiver holding register with a character in it and desires to store that character in the silo, but cannot because of lack of space. When set, this bit causes an interrupt to be generated if SIE (bit 12) is set.

Transmitter Interrupt Enable (TIE) - Bit 13

This read/write bit, when set, allows the setting of TI or NXM (bits 15 or 10) to generate a transmitter or non-existent memory interrupt request.

Storage Interrupt Enable (SIE) - Bit 12

This read/write bit, when set, allows the setting of SI (bit 14) to generate an interrupt request.

Master Clear (MC) - Bit 11

This read/write bit, when set, generates an initialize within the controller, clearing the silo, the UARTs and the registers. The exact bits cleared are discussed in Initialize, paragraph 2.5.1.

Non-Existent Memory (NXM) - Bit 10

This read-only bit is set when the controller is bus master during NPR transfer and does not receive a SSYN from the memory within 10 microseconds. Also set if a parity error is detected during the memory read operation.

Maintenance Mode (MM) - Bit 09

This read/write bit, when set, places the controller in the maintenance mode. When in maintenance mode, it is possible to write bits 07, 10 and 14, which are normally read-only. Also, the transmitted data signal is internally looped to the received data input. All line parameters must be set before setting the maintenance mode bit.

Clear Non-Existent Memory Interrupt (CNI) - Bit 08

This read/write bit, when set, clears the non-existent memory interrupt (bit 10) and clears itself.

Receiver Interrupt (RI) - Bit 07

This read-only bit, when set, indicates that the number of characters stored in silo exceeds the "alarm level" specified by the low byte of the Silo Status Register. Setting of this bit will generate an interrupt request if RIE (bit 06) is also set.

Receiver Interrupt Enable (RIE) - Bit 06

This read/write bit, when set, allows the setting of RI (bit 07) to generate an interrupt request.

Extended Address Bits (A17, A16) - Bits <05:04>

These read/write bits are bus address bits A17 and A16 for the line specified in bits <03:00>. The contents of these bits are copied into the 18-bit CAR for the line when the low-order 16 bit are loaded in the CAR. It should be noted, however, that these bits, when read, do not represent the actual status of the address bits for the selected line.

Line Number - Bits <03:00>

Each of the 16 lines served by the controller has its own storage for line parameter information, current address, and byte count. These storage locations are loaded by the program via the Line Parameter Register, Current Address Register, and Byte Count Register, but the hardware must first be told which line is to have its line parameters, current address or byte count changed. This routing is accomplished by setting the Line Selection bits to the binary address of the desired line. These bits are read/write.

3.1.2 Received Character Register (RCR) +2

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
VDP	DO	FE	PE	Line No.				Received Character							

Read only, byte addressable.

This read-once register is the bottom of the 64 word silo. Valid silo data is displayed if bit 15 is set. When this register is read the bottom word of the silo is removed, the Silo Fill Level in SSR is decremented by one and SI is reset.

Valid Data Present (VDP) - Bit 15

The bit indicates that the data present in bits <14:00> of this register are valid. It permits a character handling program to take characters from the silo until it is empty. This is done by reading this register and checking bit 15 until a word is obtained for which bit 15 is a zero.

Data Overrun (DO) - Bit 14

This bit is set when the received character was preceded by a character that was lost due to the inability of the receiver scanner to service the UART receiver holding register or because the silo is full.

Framing Error (FE) - Bit 13

This bit is set if the receiver samples a line for the first stop bit, and finds the line in a spacing condition (logical 0). This condition usually indicates the reception of a Break.

Parity Error (PE) - Bit 12

This bit is set if the parity of the received character does not agree with that designated for the line.

Line Number - Bits <11:08>

These bits indicate the line number on which the received character was received. Bit 08 is the least significant bit.

Received Character - Bits <07:00>

These bits contain the received character, right justified. The least significant bit is bit 00.

3.1.3 Line Parameter Register (LPR) +4

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
AEE	HD	Tx Speed			Rx Speed			OP	PE	0	TSB	Char. Length			

Read/write, byte addressable.

The LPR for all lines is cleared by Initialize and Master Clear.

Auto-Echo Enable (AEE) - Bit 15

When this bit is set, characters received on this line will be echoed by the controller.

Half-Duplex (HD) - Bit 14

If this bit is set, this line will operate in half-duplex mode. If reset, this line will operate in full-duplex mode. In half-duplex operation the receiver is blinded during transmission of a character.

Transmitter Speed - Bits <13:10>

The state of these bits determines the operating speed for this line's transmitter. See Table 3-1.

Table 3-1. Tx and Rx Speed Table

Transmitter Receiver	Bits				Rate
	13 9	12 8	11 7	10 6	
	0	0	0	0	Disable
	0	0	0	1	50 Baud
	0	0	1	0	75 Baud
	0	0	1	1	110 Baud
	0	1	0	0	134.5 Baud
	0	1	0	1	150 Baud
	0	1	1	0	200 Baud
	0	1	1	1	300 Baud
	1	0	0	0	600 Baud
	1	0	0	1	1200 Baud
	1	0	1	0	1800 Baud
	1	0	1	1	2400 Baud
	1	1	0	0	4800 Baud
	1	1	0	1	9600 Baud
	1	1	1	0	19200 Baud ¹
	1	1	1	1	38400 Baud ²

¹If any line is running at 19200 baud, the CS11/H2 supports a maximum of 32 lines.

²38400 baud is supported only if the firmware is revision F or above and a CP34 Distribution Panel is being used. If any line is running at 38400 baud, the CS11/H2 supports a maximum of 16 lines.

Receiver Speed - Bits <09:06>

The state of these bits determines the operating speed for this line's receiver. See Table 3-1. If the receiver speed is different from the transmitter speed, the receive speed is programmed in the split-speed baud rate generator and the UART receiver clock is connected to the generator.

Odd Parity (OP) - Bit 05

If this bit and PE (bit 04) are set, characters of odd parity will be generated on this line and incoming characters will be expected to have odd parity. If this bit is not set, but bit 04 is set, characters of even parity will be generated on this line and incoming characters will be expected to have even parity. If bit 04 is not set, the setting of this bit is immaterial.

Parity Enabled (PE) - Bit 04

If this bit is set, characters transmitted on this line will have an appropriate parity bit affixed, and characters received on this line will have their parity checked.

Two Stop Bits (TSB) - Bit 02

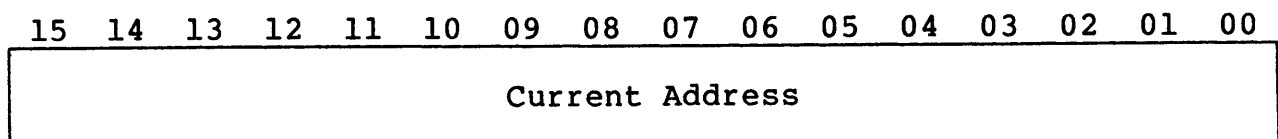
This bit, when set, conditions a line transmitting with 6-, 7-, or 8-bit code to transmit characters having two stop marks. If the line is transmitting 5-bit code, assertion of this bit causes the characters to be transmitted with 1.5 stop marks. If this bit is not asserted, one stop mark is sent.

Character Length - Bits <01:00>

These bits should be set as shown to receive and transmit characters of the length (excluding parity bit) shown:

Bit		Char. Length
01	00	
0	0	5 bit
0	1	6 bit
1	0	7 bit
1	1	8 bit

3.1.4 Current Address Register (CAR) +6

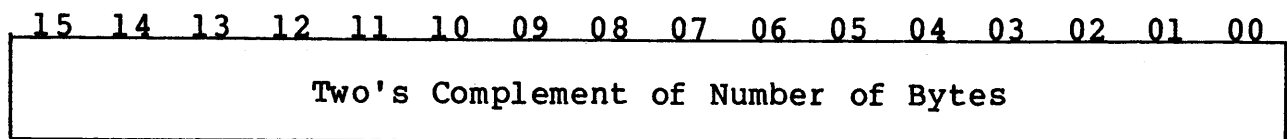


Read/write, byte addressable.

Current Address (CAR) - Bits <15:00>

This register contains 16 of the 18 memory address bits for the line specified in the SCR. This register must be loaded only after the SCR has been loaded the the desired line number and the A17 and A16 address bits. When this register is loaded, address bits <15:00> of this register and A17 and A16 from the SCR are transferred into an 18-bit CAR for the line. This register is not cleared by Initialize or Master Clear.

3.1.5 Byte Count Register (BCR) +10



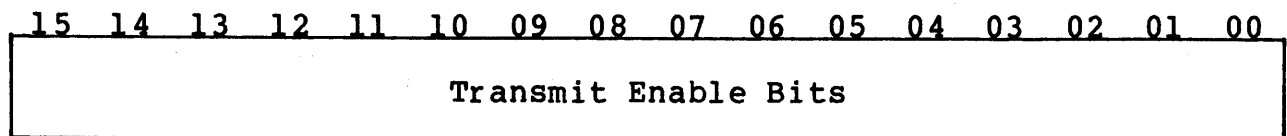
Read/write, byte addressable.

Byte Count (BCR) - Bits <15:00>

This register is loaded with the two's complement of the number of bytes to be transferred.

In the same fashion as the Line Parameter and Current Address registers, this register must not be loaded or read without first selecting the line number in SCR. This register is not cleared by Initialize or Master Clear.

3.1.6 Buffer Active Register (BAR) +12



Read/write, byte addressable.

Transmit Enable Bits - Bits <15:00>

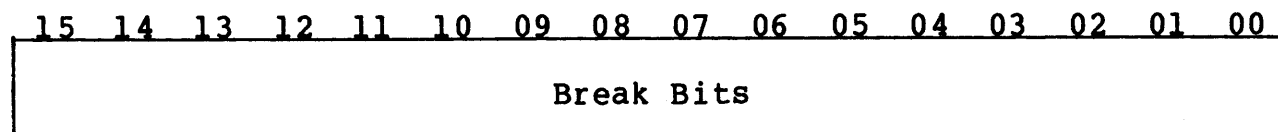
This register contains one bit for each line. The bits are set individually, using BIS instructions. Setting a bit initiates transmission on the associated line. The bit is cleared by the controller when the last character to be transmitted on that line is loaded in the the transmitter holding buffer of the UART.

The software driver should maintain an image of BAR. After setting a BAR bit to initiate transmission, the software image of BAR should be updated. Upon receipt of a transmit interrupt (indicating transmission is completed), bit 15 of SCR should be reset. Then, the driver should read BAR and perform an exclusive-or comparison between BAR and the software image. This action will identify the line that completed the transmission. When the line finishes transmission, the software image of BAR should once again be

updated. Note that although it is possible for multiple lines to finish transmission on a single interrupt, the driver need only read BAR once for each entry into the transmit service routine. (It is possible to find that no lines have finished transmission even though an interrupt was generated. In this case, the line that caused the interrupt was detected in BAR on the previous interrupt.)

It should be noted that while the clearing of a BAR bit does indicate that a new message may be sent, it does not indicate that the last characters from the preceding message have been completely sent. Specifically, two more characters are sent after the BAR bit clears. These are the last two characters of the message; one of them is starting when the BAR is cleared, and one is the final character loaded into the holding register at the same time the BAR is cleared. This effect is a normal consequence of double-buffered transmission and is mentioned here for the benefit of programmers who want to write programs that control such modem leads as Request To Send. Cleared by Initialize and Master Clear.

3.1.7 Break Control Register (BCR) +14

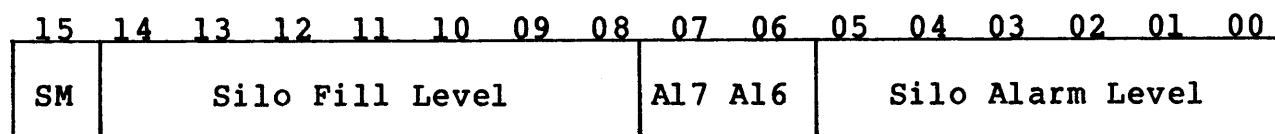


Read/write, byte addressable

Break Control - <15:00>

This register contains one bit for each line. Setting a bit in this register immediately generates a break condition on the line corresponding to that bit number; clearing the bit terminates the break condition. The break condition may be timed by sending characters during the break interval, since these characters never actually reach the line. Cleared by Initialize and Master Clear.

3.1.8 Silo Status Register (SSR) +16



Read/write, byte addressable.

This register is cleared, except for bits 07 and 06, by Initialize and Master Clear.

Silo Maintenance (SM) - Bit 15

Each time this read/write bit is set, a fixed binary pattern (125252_g) is sent to the silo for checking during maintenance. Clearing and setting loads another copy of the pattern.

Silo Fill Level - Bits <13:08>

These read-only bits are an up-down counter that indicates the actual number of characters in the silo. A full silo has a count of 040000 and an empty silo has a count of 000000.

NOTE: When the Expanded Silo option is activated, the entire upper byte (Bits <15:08>) is used to indicate the number of characters in the silo. There is no Silo Maintenance function. A full expanded silo has a count of 100000.

Extended Memory Adresss (A17, A16) - Bits <07:06>

These bits are read-only and contain the A17 and A16 bits of the current address for the line which is selected in the SCR.

Silo Alarm Level - Bits <05:00>

The program writes a number between 0 and 63 into this location corresponding to the desired silo alarm level. When the number of characters stored in the silo exceeds that number, the RI (bit 07 in SCR) is set and an interrupt request is generated if enabled by RIE (SCR bit 06).

3.2 DM11 (MODEM CONTROL) REGISTERS

The controller has two registers associated with the modem control for a 16 line group.

3.2.1 Control and Status Register (CSR) 770xx0

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RF	CF	CTS	SRF	CS	CM	MM	STP	DONE	IE	SE	BUSY	Line No.			

Read/write, byte addressable.

This register contains modem control transition information found by the scanner. It also contains maintenance controls.

Ring Flag (RF) - Bit 15

When DONE is set, this flag indicates that a Ring OFF to ON transition has been detected on the line specified by bits <03:00>. This bit is read-only and is cleared by Initialize and Clear Scanner.

Carrier Flag (CF) - Bit 14

When DONE is set, this flag indicates that a Carrier transition has been detected on the line specified by bits <03:00>. This bit is read-only and is cleared by Initialize and Clear Scanner.

Clear To Send (CTS) - Bit 13

When DONE is set, this flag indicates that a Clear To Send transition has been detected on the line specified by bits <03:00>. This bit is read-only and is cleared by Initialize and Clear Scanner.

Secondary Receive Flag (SRF) - Bit 12

When DONE is set, this flag indicates that a Secondary Receive transition has been detected on the line specified by bits <03:00>. This bit is read-only and is cleared by Initialize and Clear Scanner.

Clear Scanner (CS) - Bit 11

This write only bit, when set, clears all logic associated with the modem control scanner including the stored values of the Carrier, Clear-To-Send, Ring and Secondary Receive for all 16 lines. This function is especially useful if the programmer requires knowledge of the ON states of Carrier, Clear To Send, Ring and Secondary Receive. When the scanner is enabled (or a step is performed) following a Clear Scanner, an interrupt will occur for all ON states, as they will appear as OFF-to-ON transitions to the scanner. The Clear Scanner function is not completed until BUSY is reset by the controller.

Clear Multiplexer (CM) - Bit 10

This write only bit, when set, clears the Request To Send, Terminal Ready, Secondary Transmit, and Line Enable flip flops for all lines when a 1-bit is written into this bit position.

Maintenance Mode (MM) - Bit 09

The scanner inputs (Ring, Clear To Send, Carrier, and Secondary Receive) are set to one. This bit is read/write and is cleared by Initialize and Clear Scanner.

Step (STP) - Bit 08

This write-only bit causes the scanner to increment the Line Number and test that line for interrupt causing transitions. Step may be used in place of Scanner Enable but care should be exercised that the scan rate is great enough (milliseconds) such that double carrier transitions will be detected. DONE does not inhibit the step function. This function is not completed until BUSY is reset by the controller.

Done (DONE) - Bit 07

The DONE flag is set to indicate that the scanner has detected a transition requiring an interrupt to the program. An interrupt will occur if Interrupt Enable is set. When DONE is set, it inhibits the scanner from advancing and makes available:

- (a) the Line Number that caused the interrupt
- (b) the status of the flags (4 bits)
- (c) modem status (8 bits)

The scanner will be released again when DONE is reset. This bit is read/write and is cleared by Initialize and Clear Scanner.

Interrupt Enable (IE) - Bit 06

When set, interrupts may be generated. This read/write bit is cleared by Initialize and Clear Scanner.

Scanner Enable (SE) - Bit 05

When set, the scanner is allowed to "free run", testing all lines sequentially if the DONE is cleared. BUSY will be set as long as the scanner is enabled. This bit is read/write and is cleared by Initialize and Clear Scanner.

Busy (BUSY) - Bit 04

This read-only bit is set when scanner is cycling. It is reset after clearing or stopping the scanner, or after a step function is completed.

Line Number - Bits <03:00>

These bits are the binary address of the modem scanner's position. These bits are read/write and are cleared by Initialize and Clear Scanner.

3.2.2 Line Status Register (LSR) +2

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
0	0	0	0	0	0	0	0	RNG	CAR	CTS	SR	ST	RTS	DTR	LE

Read/write, byte addressable.

The LSR is replicated for all 16 lines. The LSR being addressed is determined by the line number in the CSR.

Ring (RNG) - Bit 07

This read-only bit is the status of the modem Ring (or Data Set Ready) lead.

Carrier (CAR) - Bit 06

This read-only bit is the status of the modem Carrier Detect lead.

Clear To Send (CTS) - Bit 05

This read-only bit is the status of the modem Clear To Send lead.

Secondary Receive (SR) - Bit 04

This read-only bit is the status of the modem Secondary Receive lead.

Secondary Transmit (ST) - Bit 03

When set, presents a MARK to the modem's Secondary Transmit lead. This bit is read/write and is cleared by Initialize and Clear Multiplexer.

Request To Send (RTS) - Bit 02

This bit is used to condition the modem to transmit if all other conditions are met. This bit is read/write and is cleared by Initialize and Clear Multiplexer.

Data Terminal Ready (DTR) - Bit 01

This bit, when set, presents an ON to the modem's Data Terminal Ready to switch the data communications equipment to the communication channel. This bit is read/write and is cleared by Initialize and Clear Multiplexer.

Line Enable (LE) - Bit 00

This bit enables the input of the Ring, Carrier, Clear To Send and Secondary Receive to be sampled by the program and to be tested for transitions. This bit is read/write and is cleared by Initialize and Clear Multiplexer.

BLANK

Section 4 INSTALLATION

This section describes the step-by-step procedure for the installation of the CS11/H2 communication controller in a Unibus environment. The following list is an outline of the procedure. Each step corresponds to a second level heading in this section (i.e., item one, Inspect the CS11, is covered in paragraph 4.1).

Emulex recommends that Section 4 be read in its entirety before installation is begun.

1. Inspect the CS11.
2. Prepare the CPU.
3. Configure the CC11 controller.
4. Configure the CP11 distribution panel.
5. Configure the CP11 interface board
6. Configure the CA11 line adapter panel
7. Install the distribution panels with the line adapters.
8. Install the CC11 controller.
9. Cable the subsystem.
10. Test the subsystem.

4.1 INSPECTION

Before unpacking the CS11, examine the packaging for any signs of damage. Notify the carrier if any damage is noted.

Make a visual inspection of the CC11 controller board and CP11 distribution panel after unpacking. Specific checks should be made for such items as bent or broken connector pins, damaged components or any other visual evidence of physical damage. The PROMs should be examined carefully to insure that they are firmly and completely seated in their sockets.

Be sure that you have received all the components that you ordered.

4.2 PREPARE THE CPU

Power down the system and switch OFF the main AC breakers. Remove the rear cabinet door to expose the RETMA rails. Slide out the CPU or SPC racks from the cabinet and otherwise make the Unibus accessible.

4.3 CONTROLLER BOARD SETUP

Reference Figure 4-1 for the location of all controller PCBA switches referred to in the paragraphs below. Table 4-2 lists the functions and factory settings of all CCl1 switches.

4.3.1 Number of DH11 Emulations

The number of DH11 emulations is selected by SW3 in accordance with Table 4-1. Each 16 line CP11 distribution panel (even if only eight lines are installed) represents one DH11; consequently, the number of emulations equals the number of panels. If more than two emulations are to be selected, two additional 2148 RAMs must be installed in sockets U40 and U41.

Table 4-1
Number of DH11 Emulations

No. Panels	SW3-	
	3	2
1	O	O
2	O	C
3	C	O
4	C	C

4.3.2 Unibus Starting Address

The DH11 and DM11 Unibus addresses are set in accordance with Table 4-3. The DH11 uses the floating address space that begins at 760010 and it is located after any DJ11s. Each CS11/H2 requires a set of eight word addresses starting with an address which is a multiple of 20_8 . All CS11s should have consecutive addresses. Each DJ11 in the system, plus one for the gap to indicate there are no more, requires a starting address which is a multiple of 10_8 starting at 760010. Therefore, the first CS11/H2 will have a starting address of 760020 if there are no DJ11s, and a starting address of 760040 if there are one or two DJ11s.

If more than one DH11 is being emulated, select an initial starting address with enough starting addresses above it for each emulation. The starting addresses will be contiguous. That is, if three CP11 distribution panels are installed (three DH11 emulations, essentially) and the starting address selected is 760060, then the CCl1 controller will also respond to accesses in the address ranges starting at 760100 and 760120. The second and third starting addresses represent the second and third DH11 devices that are being emulated.

The starting address for the DM11 is selected by the same switches that select the DH11 address (see Table 4-3). There is a DM11 for each DH11. The DM11 addresses are a multiple of 10_8 .

Table 4-2
CC11 Factory Switch Definitions/Factory Configuration

SW	Off	On	Fact	Function	Section
SW1-1	Disable	Enable	Off	Expanded Silo Option	4.3.5
SW1-2	-	-	Off*	Not Used	
SW1-3	-	-	NS	DH/DM Vector Address	4.3.3
SW1-4	-	-	NS	DM Vector Address Assignment	4.3.3
SW1-5	Disable	Enable	Off	DH/DM Vector Interleave	4.3.3.3
SW1-6	Disable	Enable	Off	Force 2 Stop Bits All Lines	4.3.4
SW2-1	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-2	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-3	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-4	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-5	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-6	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-7	-	-	NS	DM Vector Address Assignment	4.3.3
SW2-8	-	-	NS	DM Vector Address Assignment	4.3.3
SW3-1	Run	Halt/Reset	Off	Controller Run/Halt	4.3.5
SW3-2	-	-	NS	Number of Emulations	4.3.1
SW3-3	-	-	NS	Number of Emulations	4.3.1
SW3-4	Halt	Override	On	Override Line Test Failures	4.10.1
SW4-1	-	-	NS	DH/DM Bus Address Assignment	4.3.2
SW4-2	-	-	NS	DH/DM Bus Address Assignment	4.3.2
SW4-3	-	-	NS	DH/DM Bus Address Assignment	4.3.2
SW4-4	-	-	NS	DH/DM Bus Address Assignment	4.3.2
SW4-5	-	-	Off*	Not Used	
SW4-6	-	-	Off*	Not Used	

On = Closed

Off = Open

* = Switch must be in factory setting

NS = No Standard

Fact = Factory switch setting

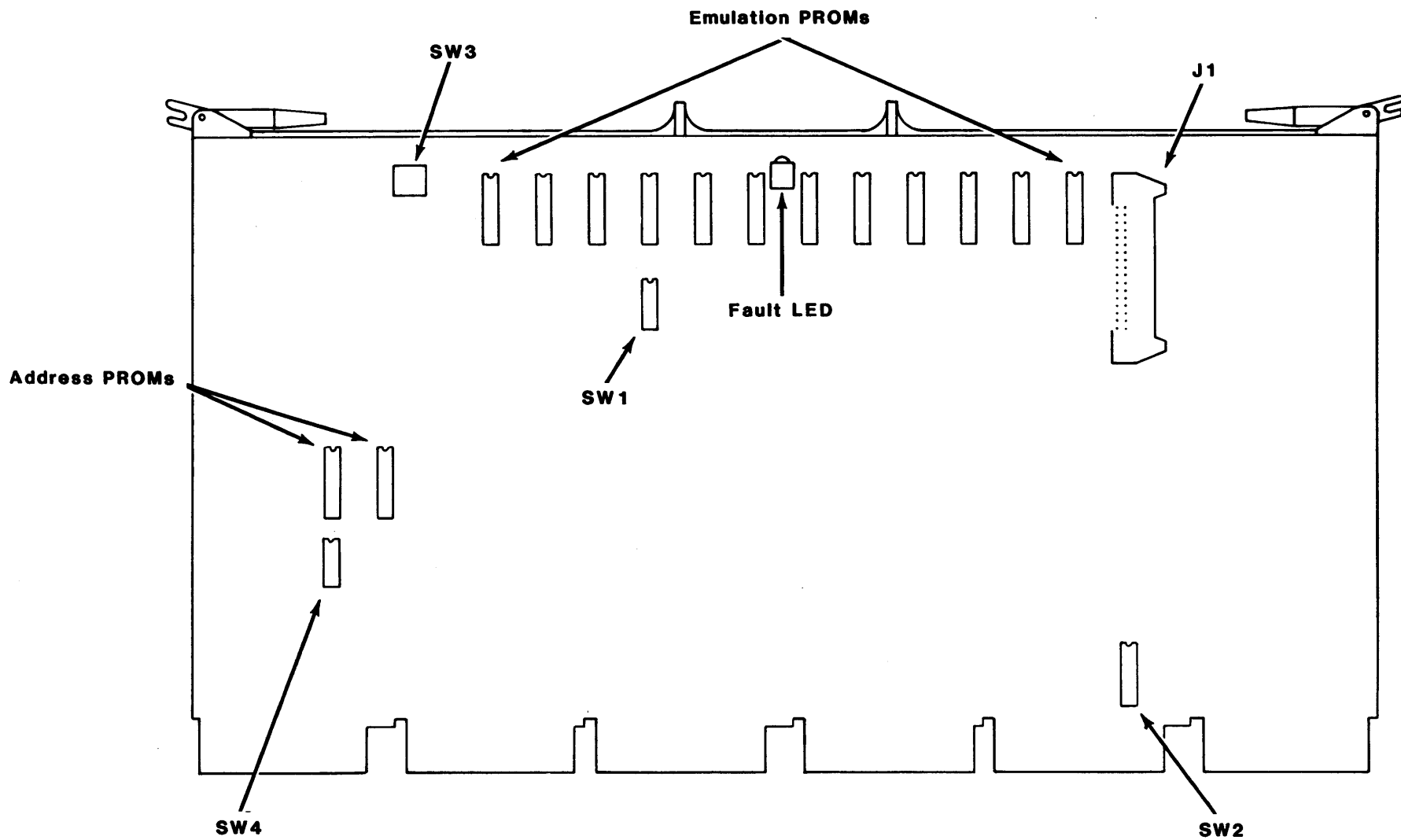
Table 4-3
Unibus Starting Address Selection

Address Range 1*		Address Range 2		SW4-			
DH11	DM11	DH11	DM11	4	3	2	1
760020	770500	760220	770600	O	O	O	O
760040	770510	760240	770610	O	O	O	C
760060	770520	760260	770620	O	O	C	O
760100	770530	760300	770630	O	O	C	C
760120	770540	760320	770640	O	C	O	O
760140	770550	760340	770650	O	C	O	C
760160	770560	760360	770660	O	C	C	O
760200	770570	760400	770670	O	C	C	C
760220	770600	760420	770700	C	O	O	O
760240	770610	760440	770710	C	O	O	C
760260	770620	760460	770720	C	O	C	O
760300	770630	760500	770730	C	O	C	C

*Standard Address Range

Table 4-4
DH11 Vector Address Selection

Addr	SW1-		SW2-			Addr	SW1-		SW2-		
	3	8	7	6	5		3	8	7	6	5
300	0	0	0	0	0	500	C	0	0	0	0
310	0	0	0	0	C	510	C	0	0	0	C
320	0	0	0	C	0	520	C	0	0	C	0
330	0	0	0	C	C	530	C	0	0	C	C
340	0	0	C	0	0	540	C	0	C	0	0
350	0	0	C	0	C	550	C	0	C	0	C
360	0	0	C	C	0	560	C	0	C	C	0
370	0	0	C	C	C	570	C	0	C	C	C
400	0	C	0	0	0	600	C	C	0	0	0
410	0	C	0	0	C	610	C	C	0	0	C
420	0	C	0	C	0	620	C	C	0	C	0
430	0	C	0	C	C	630	C	C	0	C	C
440	0	C	C	0	0	640	C	C	C	0	0
450	0	C	C	0	C	650	C	C	C	0	C
460	0	C	C	C	0	660	C	C	C	C	0
470	0	C	C	C	C	670	C	C	C	C	C



4-5

Figure 4-1 CC11 Controller Board

Table 4-5
DM11 Vector Address Selection

Addr	SW1-		SW2-		2	1	Addr	SW1-		SW2-		2	1
	3	4	4	3				3	4	4	3		
300	0	0	0	0	0	0	500	C	0	0	0	0	0
304	0	0	0	0	0	C	504	C	0	0	0	0	C
310	0	0	0	0	C	0	510	C	0	0	0	C	0
314	0	0	0	0	C	C	514	C	0	0	0	C	C
320	0	0	0	C	0	0	520	C	0	0	C	0	0
324	0	0	0	C	0	C	524	C	0	0	C	0	C
330	0	0	0	C	C	0	530	C	0	0	C	C	0
334	0	0	0	C	C	C	534	C	0	0	C	C	C
340	0	0	C	0	0	0	540	C	0	C	0	0	0
344	0	0	C	0	0	C	544	C	0	C	0	0	C
350	0	0	C	0	C	0	550	C	0	C	0	C	0
354	0	0	C	0	C	C	554	C	0	C	0	C	C
360	0	0	C	C	0	0	560	C	0	C	C	0	0
364	0	0	C	C	0	C	564	C	0	C	C	0	C
370	0	0	C	C	C	0	570	C	0	C	C	C	0
374	0	0	C	C	C	C	574	C	0	C	C	C	C
400	0	C	0	0	0	0	600	C	C	0	0	0	0
404	0	C	0	0	0	C	604	C	C	0	0	0	C
410	0	C	0	0	C	0	610	C	C	0	0	C	0
414	0	C	0	0	C	C	614	C	C	0	0	C	C
420	0	C	0	C	0	0	620	C	C	0	C	0	0
424	0	C	0	C	0	C	624	C	C	0	C	0	C
430	0	C	0	C	C	0	630	C	C	0	C	C	0
434	0	C	0	C	C	C	634	C	C	0	C	C	C
440	0	C	C	0	0	0	640	C	C	C	0	0	0
444	0	C	C	0	0	C	644	C	C	C	0	0	C
450	0	C	C	0	C	0	650	C	C	C	0	C	0
454	0	C	C	0	C	C	654	C	C	C	0	C	C
460	0	C	C	C	0	0	660	C	C	C	C	0	0
464	0	C	C	C	0	C	664	C	C	C	C	0	C
470	0	C	C	C	C	0	670	C	C	C	C	C	0
474	0	C	C	C	C	C	674	C	C	C	C	C	C

4.3.2.1 Alternate Unibus Starting Addresses

One alternate address range is available on the CS11/H2. This alternate range requires a different address decode PROM, which may be ordered from Emulex. The table below shows the address ranges and the part number for the alternate PROM.

Address Range	PROM Number	PCBA Location	Part Number
1	018A 019A	U59A U59B	Standard
2	018A 797A	U59A U59B	CC1111727

4.3.3 Interrupt Vector Address

4.3.3.1 DH11 Vector

The DH11 interrupt vector address is set by switches SW1-3, SW2-8, SW2-7, SW2-6, and SW2-5 in accordance with Table 4-3. Each DH11 requires two interrupt vectors. The receiver vector is XX0; the transmitter vector is XX4. The DH11 falls in behind the DC11, KL11, DP11, DN11, DM11, DR11, PA611, DX11, DL11 and DJ11. Remember to count the vectors of the associated DM11s and any other DM11s or DH11s with lower Unibus addresses.

4.3.3.2 DM11 Vector

The DM11 interrupt vector address is set by switches SW1-3, SW1-4, SW2-4, SW2-3, SW2-2, and SW2-1 in accordance with Table 4-4. Each DM11 requires one interrupt vector. The vector addresses are assigned starting at 300. The DM11 falls in behind the DC11, KL11, DP11 and DN11. Remember to count other DM11s on the bus which have lower Unibus addresses.

4.3.3.3 Interleaving DH11 and DM11 Vector Addresses

In order to interleave the DH11 and DM11 interrupt vector address option switch SW1-5 must be closed. When enabling this option, it is important to set the addresses so that they do not overlap. This can be accomplished by setting the first DH11 vector 10₈ higher than the first DM11 vector. All DM11 vectors must start on modulo 20₈ boundaries. Thus, if the first DM11 vector is set at 300, the first DH11 vector must be set at 310, and the second DH11 vector will occupy 314. The next open address is 320, so the DM11 vector will be assigned to that and so on. The chart below provides a sampling of typical interleaved interrupt vector assignments.

<u>DM11</u>	<u>DH11</u>
300	310
	314
320	330
	334
340	350
	354
360	370
	374

4.3.4 Force Two Stop Bits Option

This option overrides program control of the number of stop bits per character. When this option is selected, all local CP11 channels will transmit two stop bits with every character. This option is useful in situations where a continuous stream of asynchronous characters are being transmitted and the transmit station's baud rate is slightly faster than the receive station's. In some cases, one stop bit between characters does not allow enough time for the receive UART to sync on the start bit immediately following the single stop bit. Two stop bits simply allows more time between characters to ensure that the receiving UART has enough time internally to set up to see the next start bit.

CC11 Force Two Stop Bits Option

Switch	Off	On	Factory
SW1-6	Disable	Enable	Off

4.3.5 CC11 Run/Halt/Reset Switch

When placed in the closed/ON position, switch 3-1 halts and resets the CC11 microprocessor. Upon placing the switch back in the open/OFF position, the CC11 microcode will execute the complete self test and initialization process.

CC11 Run/Halt/Reset

Switch	Off	On	Factory
SW3-1	Normal	Halt/Reset	Off

4.3.6 Jumpers

Table 4-6 shows factory configurations and assignments for all jumpers on the CCl1 controller module.

Table 4-6. Jumper Definitions/Factory Configuration

Jumper	In	Out	Factory	Function
A-B	2K	1K	In	Microprogram PROM size
C-D	Normal	Test	In	Production Test Jumper
E-G	-	-	In	Enables Extra RAM
H-K	-	-	In	Enables Extra RAM
F-J	-	-	Out	Not Used--Must be Out

Note

Jumper A-B must be in for Revision D and above firmware. It must be out for lower revision levels.

4.3.6.1 Expanded Silo Option

Setting option switch SW1-1 ON will enable the Expanded Silo Option. However, the option requires that two RAM ICs (2148) be placed in sockets U21 and U22. Jumper connections must be made from E to G and from H to K.

4.4 CP11 DISTRIBUTION PANEL CONFIGURATION

4.4.1 Panel Numbering

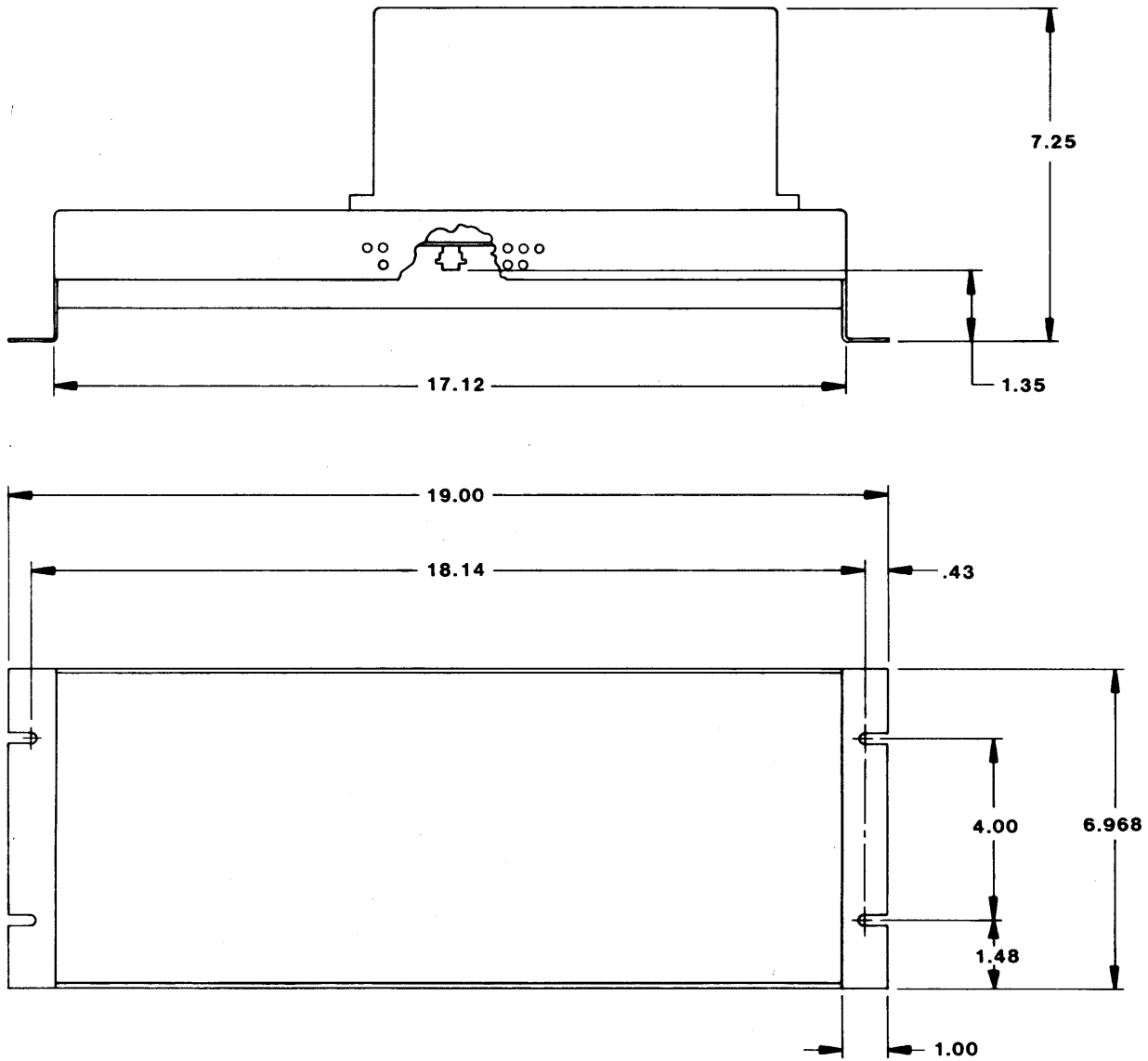
There is no address selection to be done on the CP11 Distribution Panel. Each panel takes on a number corresponding to its position on the daisy-chain cable. The number of CP11 panels is selected by switches SW3-2 and SW3-3 on the CCl1 controller PCBA. See Table 4-1 for switch setting information.

4.4.2 International Power Supply Conversion Instructions

The power supply accompanying your order is wired for 115 VAC. To convert the power supply to 220 V proceed as follows:

- 1) Make sure the power supply is not plugged in.

Figure 4-2. CP11 Distribution Panel Physical Dimensions



ALL DIMENSIONS IN INCHES

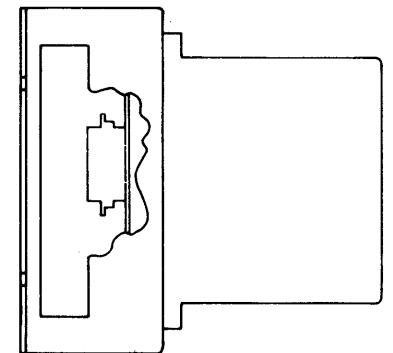


Figure 4-4 CP11 Distribution Panel Physical Dimensions

- 2) Replace the existing 1A slow/blow fuse with the enclosed 1/2A slow/blow fuse. The fuse plug is on the left hand side when viewed from the front.
- 3) Move the slide switch to the 230 v position. The switch is next to the fuse plug.
- 4) Remove the existing AC plug and replace it with the type desired for your application. The wire coloring code is: green--safety ground; white--neutral; black--AC power.

4.5 CP11 INTERFACE BOARD SETUP

4.5.1 Interface Board Option Switches

The CP11 Interface Board has four DIP switches that are used to select various options on controllers with Revision D firmware or higher. **These switches have no effect on firmware sets below Revision D and should be ignored.** The four switches are labeled SW1(L), SW1(R), SW2(L), and SW2(R). Switch SWx(L) configures the left adapter panel and SWx(R) configures the right. Figure 4-3 shows the switch locations on the interface board. Table 4-7 lists definitions of switch settings.

To access the interface board, use the following procedure:

1. Turn OFF the ac power to the distribution panel by unplugging the ac line cord.
2. Unscrew the knurled screw at each corner of the line adapter panel. The captive screws will dangle loosely when free.

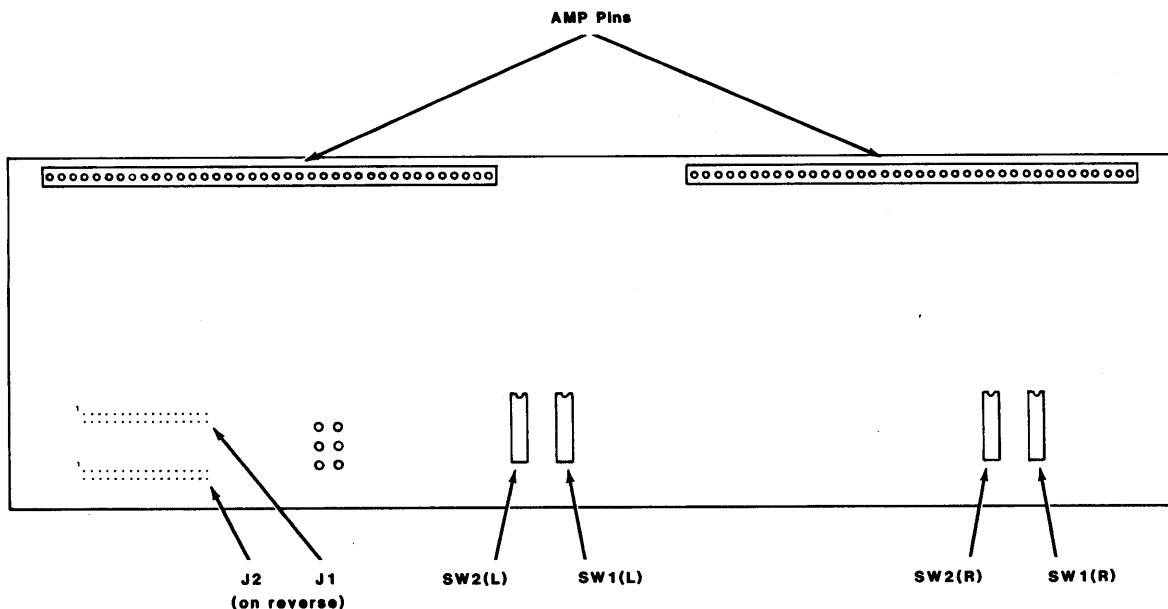


Figure 4-3. Interface Board Switch Positions

Table 4-7
 CP11 Interface Board Switch Function/Factory Configuration

SW	Off	On	Fact	Function	Section
SW1-1 (L)	Disable	Enable	Off	Channel 0 CTS Flow Control	4.5.1.1
SW1-2 (L)	Disable	Enable	Off	Channel 1 CTS Flow Control	4.5.1.1
SW1-3 (L)	Disable	Enable	Off	Channel 2 CTS Flow Control	4.5.1.1
SW1-4 (L)	Disable	Enable	Off	Channel 3 CTS Flow Control	4.5.1.1
SW1-5 (L)	Disable	Enable	Off	Channel 4 CTS Flow Control	4.5.1.1
SW1-6 (L)	Disable	Enable	Off	Channel 5 CTS Flow Control	4.5.1.1
SW1-7 (L)	Disable	Enable	Off	Channel 6 CTS Flow Control	4.5.1.1
SW1-8 (L)	Disable	Enable	Off	Channel 7 CTS Flow Control	4.5.1.1
SW2-1 (L)	Disable	Enable	Off	Force DTR/RTS Active	4.5.1.2
SW2-2 (L)	1 X	16 X	Off	External Clock for CALL/V	4.5.1.3
SW2-3 (L)	-	-	Off*	Not Used	
SW2-4 (L)	-	-	Off*	Not Used	
SW2-5 (L)	-	-	Off*	Not Used	
SW2-6 (L)	-	-	Off*	Not Used	
SW2-7 (L)	-	-	Off*	Not Used	
SW2-8 (L)	-	-	Off*	Not Used	
SW1-1 (R)	Disable	Enable	Off	Channel 0 CTS Flow Control	4.5.1.1
SW1-2 (R)	Disable	Enable	Off	Channel 1 CTS Flow Control	4.5.1.1
SW1-3 (R)	Disable	Enable	Off	Channel 2 CTS Flow Control	4.5.1.1
SW1-4 (R)	Disable	Enable	Off	Channel 3 CTS Flow Control	4.5.1.1
SW1-5 (R)	Disable	Enable	Off	Channel 4 CTS Flow Control	4.5.1.1
SW1-6 (R)	Disable	Enable	Off	Channel 5 CTS Flow Control	4.5.1.1
SW1-7 (R)	Disable	Enable	Off	Channel 6 CTS Flow Control	4.5.1.1
SW1-8 (R)	Disable	Enable	Off	Channel 7 CTS Flow Control	4.5.1.1
SW2-1 (R)	Disable	Enable	Off	Force DTR/RTS Active	4.5.1.2
SW2-2 (R)	1 X	16 X	Off	External Clock for CALL/V	4.5.1.3
SW2-3 (R)	-	-	Off*	Not Used	
SW2-4 (R)	-	-	Off*	Not Used	
SW2-5 (R)	-	-	Off*	Not Used	
SW2-6 (R)	-	-	Off*	Not Used	
SW2-7 (R)	-	-	Off*	Not Used	
SW2-8 (R)	-	-	Off*	Not Used	

Off = Open
 On = Closed
 * = must be set to factory setting
 L = switch function applies to left adapter panel
 R = switch function applies to right adapter panel

3. Grasp the handles in the upper left and right corners of one of the adapter panels and pull the adapter panel off the AMP MOD 1 pins on the distribution panel. Repeat for the other adapter.

4.5.1.1 CTS Flow Control

The Clear to Send (CTS) flow control option allows devices to use CTS for their receive data flow control instead of the XON/XOFF flow control typically used by DEC equipment. When this option is selected, dropping CTS at a channel causes the CS11 to halt transmission on a character boundary. Because this action is transparent to the host software, it is not necessary to specify modem control for the lines involved. The state of the CTS line is reflected in the Line Status Register whether or not this option is selected.

This option is enabled for individual channels on a line adapter using switch SW1-X(L) and switch SW1-X(R) on the interface board. SW1-X(L) affects the left-hand adapter on the distribution panel and SW1-1(R) affects the right-hand adapter.

CTS Flow Control

Switch	OFF	ON	Factory
SW1-X(X)	Disable	Enable	OFF

4.5.1.2 Force DTR/RTS Active

This option causes the Data Terminal Ready (DTR) and Request to Send (RTS) modem control signals for the eight RS-232-C connectors on the adapter to be forced active when the host computer writes to the Line Parameter Register associated with a particular channel. The signals remain active until the controller is reset or until the host computer writes into the Line Status Register to change these signals.

This option is enabled for all channels on a line adapter using switch SW2-1(L) and switch SW2-1(R) on the interface board. SW2-1(L) affects the left-hand adapter on the distribution panel and SW2-1(R) affects the right-hand adapter. See Section 3 for a description of programming controller register functions.

Force DTR/RTS Active

Switch	OFF	ON	Factory
SW2-1(X)	Disable	Enable	OFF

4.5.1.3 Sampling Rate for CALL/V Line Adapter

On the CALL/V Line Adapter, there are external clock inputs for transmit and receive clocks. These are used by the USARTs on the CALL/V for sampling the incoming data, and for clocking the outgoing data. The data may be sampled once per bit period (1X), or 16 times per bit period (16X). The position of this switch determines how the external clocks will be used by the USARTs.

The sampling rate for all channels on a line adapter is selected using switch SW2-2(L) and switch SW2-2(R) on the interface board. SW2-2(L) affects the left-hand adaptor on the distribution panel and SW2-2(R) affects the right-hand adaptor.

NOTE

Bits <06:13> in the Line Parameter Register must be set to ones. Bits <06:09> set the reception sampling rate and bits <10:13> set the transmission sampling rate.

Sampling Rate for CALL/V Line Adapter

Switch	OFF	ON	Factory
SW2-2(X)	1X	16X	OFF

NOTE

This option applies only to the CALL/V Line Adapter. The CALL/H and CALL/C Line Adapters are unaffected by the position of this switch.

4.6 LINE ADAPTER CONFIGURATION

There are four line adapter panels available for the CP11. Two of them, the CALL/A and the CALL/V, may only be used with firmware revisions D and above. All four are listed in Table 4-8.

Table 4-8. CALL Line Adapter Models

CALL/H	RS-232-C interface. Asynchronous. DB25-P type connectors. Standard line adapter panel for CS11/H2.
CALL/C	20 milliamp current loop interface. Terminal block type connectors.
CALL/V	RS-232-C interface. Synchronous or Asynchronous. DB25-P type connectors. External Tx and Rx clock inputs on pins 9 and 25. Rev D firmware and above only.
CALL/A	RS-232-C interface. Asynchronous. DB25-P type connectors. Carrier and Clear-To-Send modem control signals are hard-wired to UART inputs for automatic control. Rev D firmware and above only.

4.6.1 Option Selection

There are several options that can be selected on each line adapter panels using jumpers. These options are described for each panel in the sections that follow.

The procedure below is a general one to be used for exposing the jumpers when reconfiguring any type of adapter. Refer to the appropriate section for specific jumper connections when you reach step 7. When configuring the adapters for initial installation, only steps 2 through 11 will apply as the distribution panel will not yet have been installed.

- 1) Unplug the 34-wire ribbon cable from the CP11 Distribution Panel.
- 2) Turn off the AC power to the Distribution Panel by unplugging the AC line cord.
- 3) Unscrew the knurled screw at each corner of the adapter. They need not be completely removed.
- 4) Grasp the handles in the upper left and right hand corners of the adapter and pull the adapter from the AMP MOD 1 pins on the Distribution Panel.
- 5) Remove the four screws that hold the two panel handles in place and remove the handles.
- 6) Unscrew the four counterset screws that hold the face plate on the adapter PCBA and remove the face plate.

- 7) Make the wire wrap changes as required.
- 8) Replace the face plate on the adapter PCBA.
- 9) Replace the two panel handles.
- 10) Fit the adapter panel to the AMP pins and press the panel home.
- 11) Tighten the four knurled screws.
- 12) Plug in the Distribution Panel's AC line cord.
- 13) Plug in the 34-wire cable.
- 14) All of the Adapter Panel LEDs will be lit. Move the LINE TEST slide switch from the OFF to the INT position and back again. This will cause the controller to test each channel. All of the LEDs should go out.

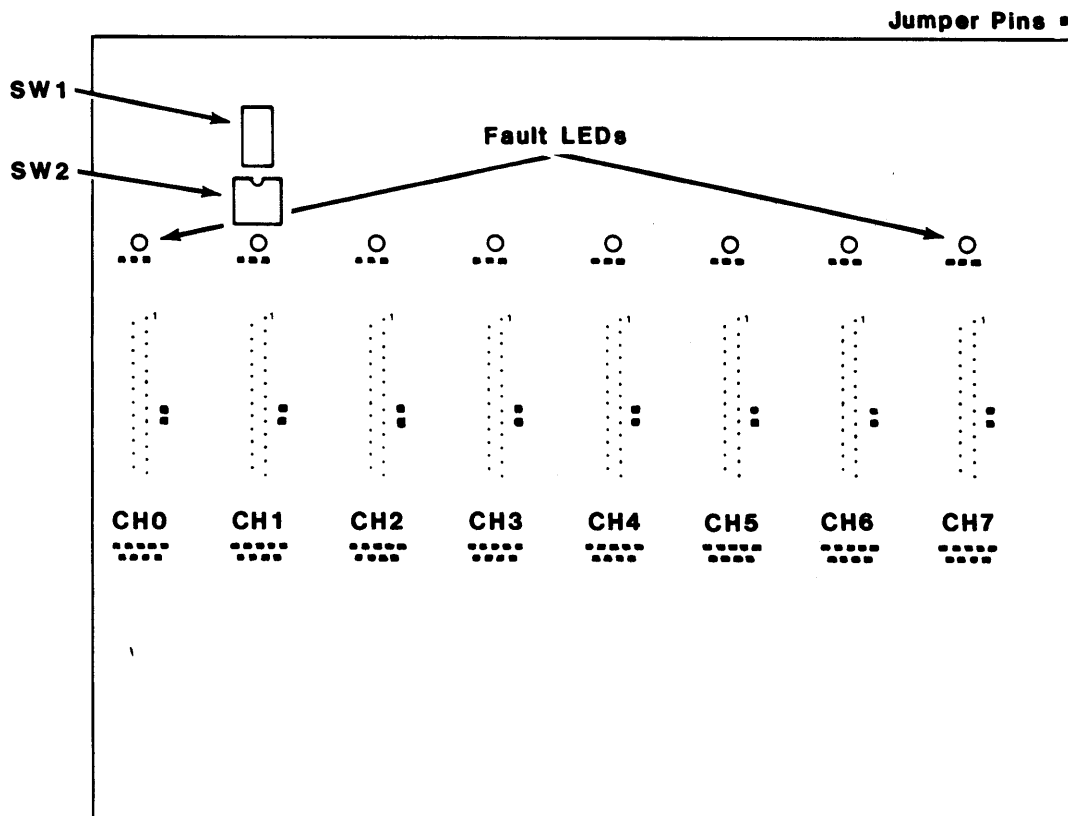


Figure 4-4. CALL/H Line Adapter

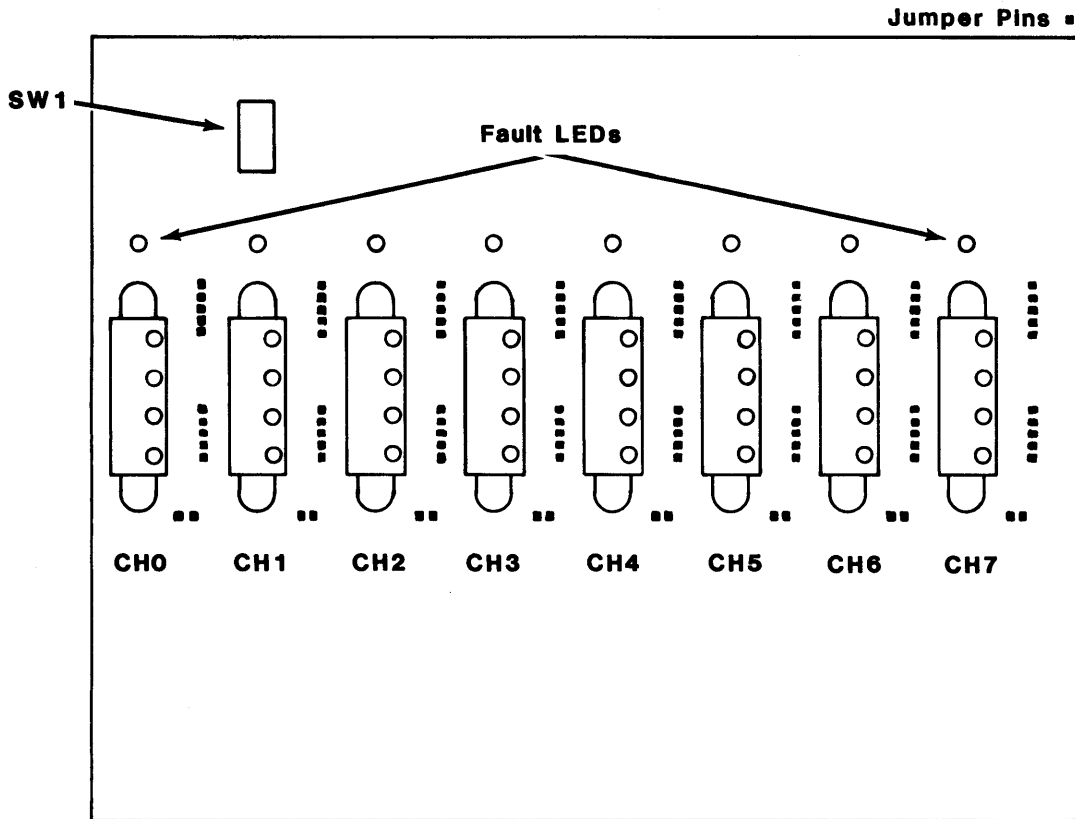


Figure 4-5. CALL/C Line Adapter

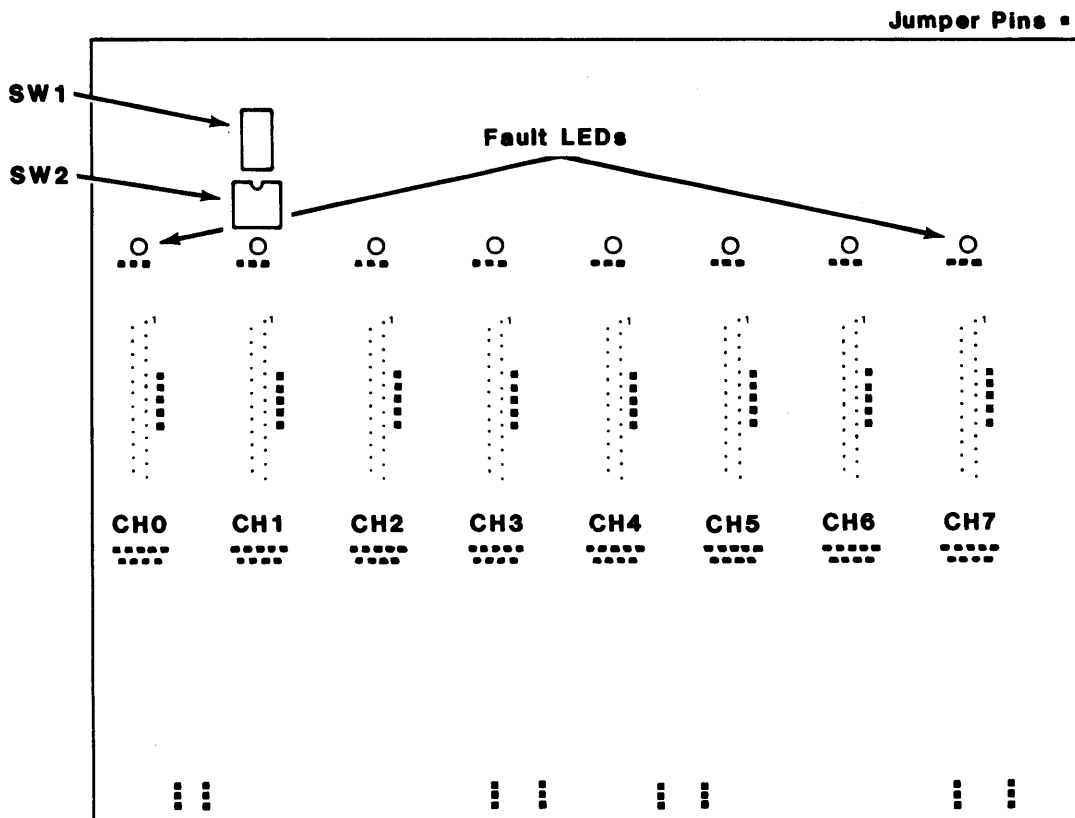


Figure 4-6. CALL/V Line Adapter

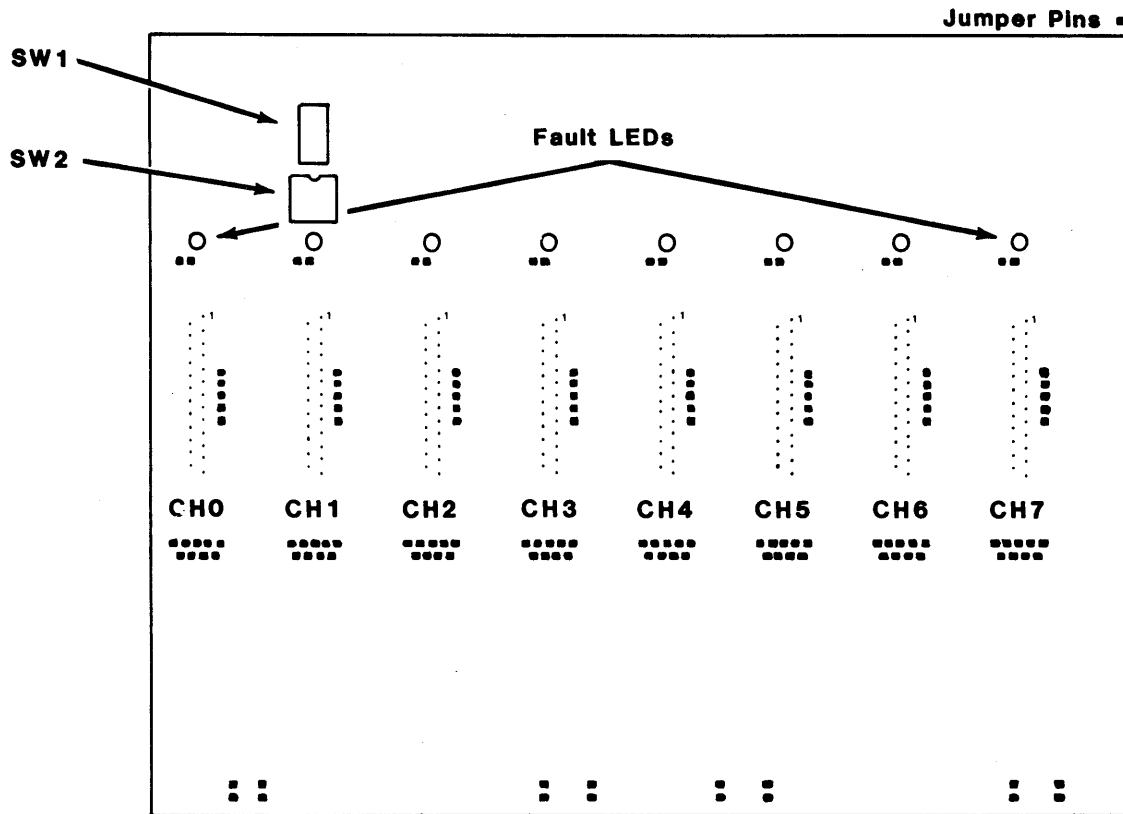


Figure 4-7. CALL/A Line Adapter

4.6.2 CALL/H Option Selection

4.6.2.1 Compatibility Mode Selection

Selection between the CS11/H1 and CS11/H2 compatibility modes for all the channels on each individual CALL/H is done by SW2 (located on each CALL/H PCBA as shown in Figure 4-4). Switch positions are shown below:

Mode	SW2-			
CS11/H2	0	1	0	1
CS11/H1	0	0	0	1

0 = OFF/Open 1 = ON/Closed

4.6.2.2 Pinning Assignment Options

Pin assignment options are implemented using a group of jumpers below each port on the line adapter. The dress panel must be removed to reach the jumpers, which are clearly marked on the PCBA. Figure 4-8 shows a channel schematic and the positions of factory installed jumpers and tables 4-9 and 4-10 list pinning options.

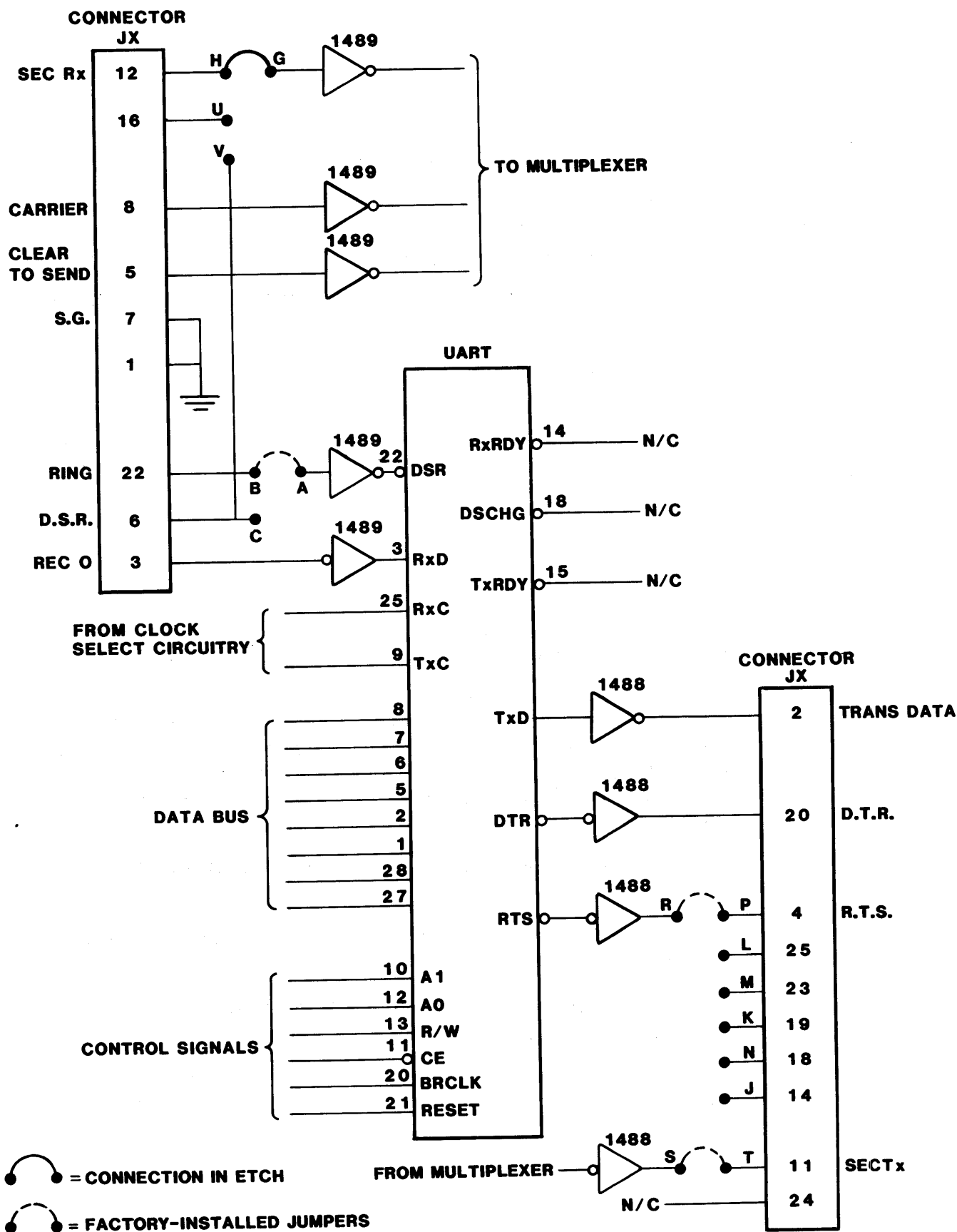


Figure 4-8. CALL/H Channel Schematic

Table 4-9.
Jumper Connections for CALL/H, CALL/V, and CALL/A

Connection	Function
A to B	Connects RING (pin 22) to DSR input on UART.
Y to X	Connects baud rate generator to external clock input on UART (CALL/V only).
R to P	Connects RTS output on UART to pin 4.
S to T	Connects Sec TX output to pin 11.

Table 4-10
Pinning Options for CALL/H, CALL/V, and CALL/A

- 1) RS-232 Secondary Receive and Secondary Transmit (pins 16 and 14, respectively) rather than Bell 202C pinning assignments: Remove S-T; Jumper S-J; Jumper U-G on back of board (cut etch H-G if necessary to isolate pin 12).
- 2) Substitute Data Set Ready for Ring: Remove B-A; Jumper C-A.
- 3) For 103 E,G,H,J modems, connect Busy (pin 25) with RTS (pin 4): Jumper R-L.
- 4) For 212 A modems, connect Make Busy (pin 18) with RTS (pin 4): Jumper R-N.
- 5) Connect 811B Received Signal Element Timing (CALL/V only), pin 17 to Secondary Receive: Jumper F-G and cut etch E-D on back of board.

Note

No special setup is necessary if the CS11/H2 is to be used in a normal DH11/DM11 application. The jumpers may be left in the factory installed configuration.

4.6.2.3 Line Test Switch

The Line Test Switch, SW1, should be OFF for normal operation. The location of the switch is shown in Figure 4-4.

4.6.3 CALL/C Option Selection

4.6.3.1 Configuration for Active or Passive

Both transmission and reception on CALL/C channels may be configured independently for active or passive current sources using jumpers beside each port. Figure 4-9 shows a channel schematic and the positions of factory installed jumpers. Configuration options are listed in Table 4-11.

Table 4-11
CALL/C Line Adapter Options

Option	Jumpers	Description	Factory
1.	A - B C - D	Active Transmitter	X
2.	F - G H - J	Active Receiver	X
3.	A - D	Passive Transmitter	
4.	F - J	Passive Receiver	
5.	A - B D - E	Long Line Active Transmitter	
6.	F - G J - K	Long Line Active Receiver	
7.	L - M	Install Receive Filter	

Note: Install only the jumpers indicated to select each option. All other jumpers should be removed.

4.6.3.2 Line Test Switch

The Line Test Switch, SW1, should be OFF for normal operation. See Figure 4-5 for the location of this switch.

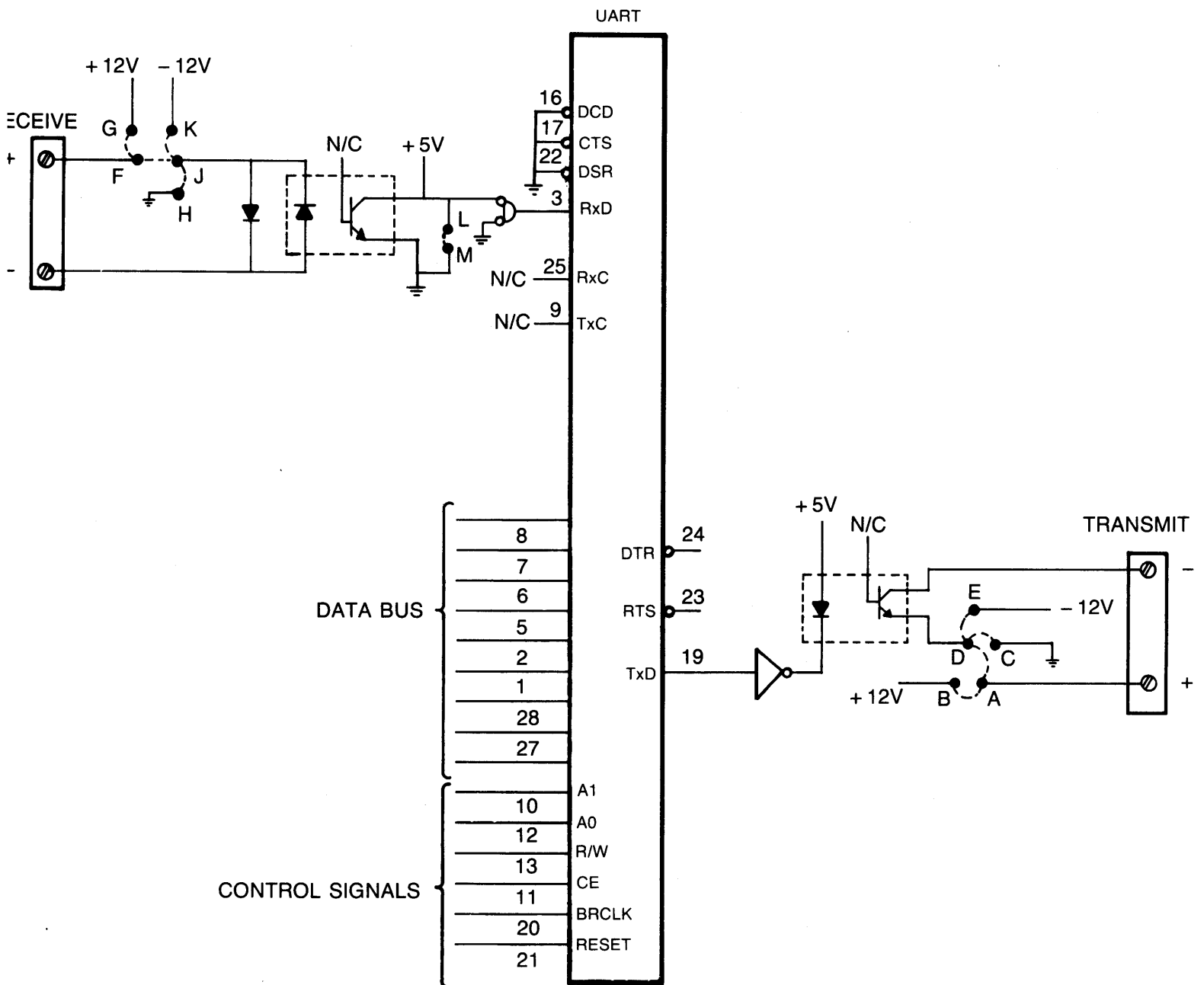


Figure 4-9. Call/C Channel Schematic

4.6.4 CALL/V Option Selection (Rev D Firmware Only)

The CALL/V line adapter panel may be used with Revision D and above firmware. This panel may not be used with firmware sets below Revision D.

4.6.4.1 Compatibility Mode Selection

Selection between the CS11/H1 and CS11/H2 compatibility modes for all the channels on each CALL/V is done with SW2 (located on each CALL/V PCBA as shown in Figure 4-6). Switch positions are shown below:

Mode	SW2-			

CS11/H2	0	0	1	0
CS11/H1	0	1	1	0

0 = OFF/Open		1 = ON/Closed		

4.6.4.2 Pinning Assignment Options

Pin assignment options are implemented using a group of jumpers below each port on the line adapter. The dress panel must be removed to reach the jumpers, which are clearly marked on the PCBA. Figure 4-10 shows a channel schematic and the positions of factory installed jumpers. Tables 4-9 and 4-10 list pinning options.

Note

No special setup is necessary is the CS11/H2 is to be used in a normal DH11/DM11 application. The jumpers may be left in the factory installed configuration.

4.6.4.3 Line Test Switch

The Line Test Switch, SW1, should be OFF for normal operation. The location of the switch is shown in Figure 4-6.

4.6.5 CALL/A Option Selection (Rev D Firmware Only)

The CALL/A Line Adapter Panel may be used with Revision D and above firmware. This panel may not be used with firmware sets below Revision D.

4.6.5.1 Compatibility Mode Selection

Two type code jumpers must be installed on the component side of the CALL/A line adapter for use with the CS11/H2. The dress panel must

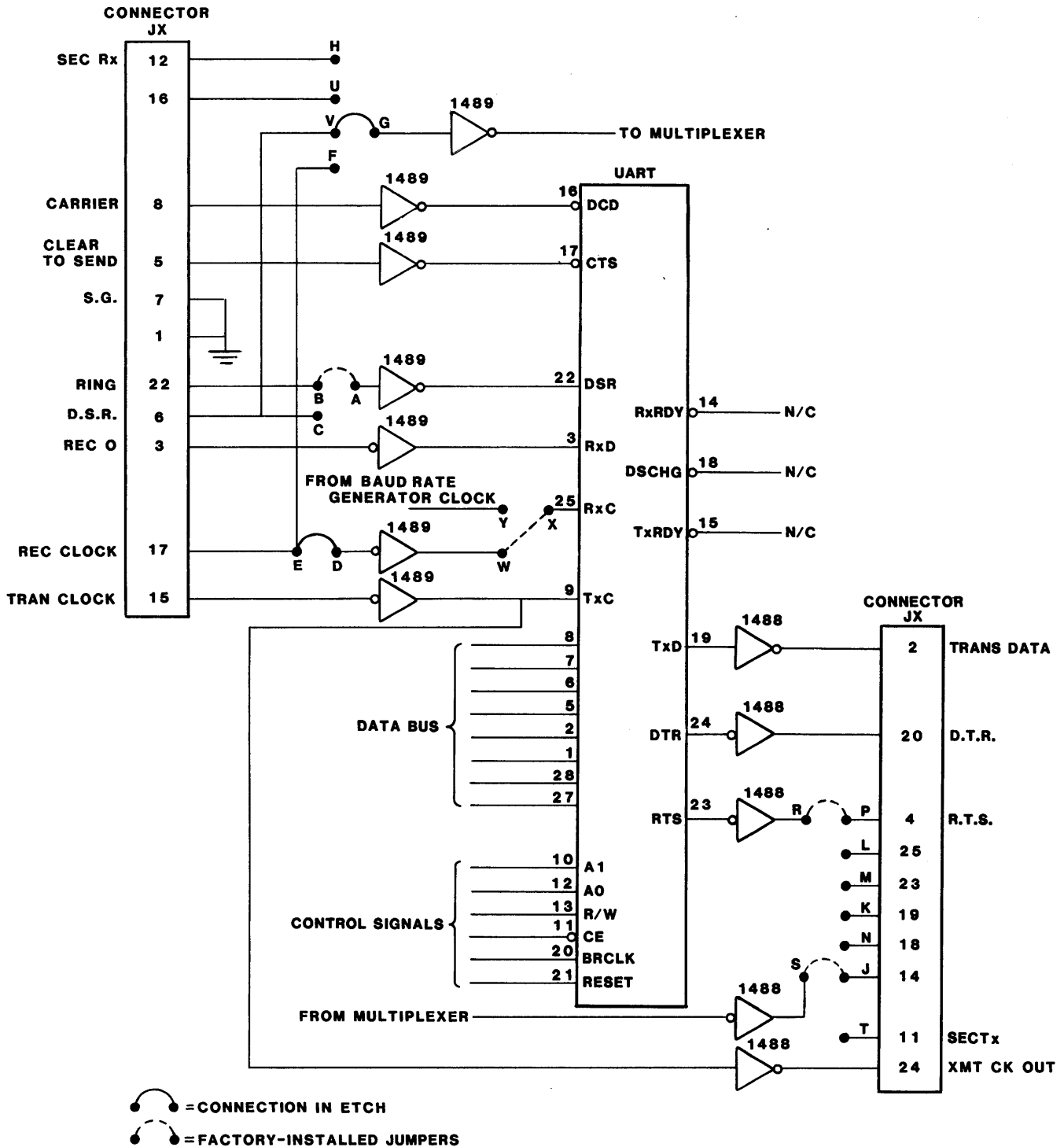


Figure 4-10. Call/A and Call/V Channel Schematic

be removed to reach the jumpers. The jumpers are labeled Z2 and Z3. Some older adapters may not have these these jumpers installed, so it is best to check.

4.6.5.2 Pinning Assignment Options

Pinning assignment option are implemented using a group of jumpers below each port on the line adapter. The dress panel must be removed to reach the jumpers, which are clearly marked on the PCBA. Figure 4-10 shows a channel schematic and the positions of factory installed jumpers. Table 4-9 and 4-10 list pinning options.

Note

No special setup is necessary is the CS11/H2 is to be used in a normal DH11/DM11 application. The jumpers may be left in the factory configuration.

4.6.5.3 Line Test Switch

The Line Test Switch, SW1, should be OFF for normal operation. The location of the switch is shown in Figure 4-7.

4.7 CP11 DISTRIBUTION PANEL INSTALLATION

The distribution panels can be installed with the line adapters in place. See Figure 4-2 for panel dimensions pertinent to mounting.

The distribution panels are usually mounted to the rear RETMA rails of the cabinet. The panel is recessed so that the connectors and their cables do not get in the way of the rear door of the cabinet.

NOTES: If a panel is not to be mounted in the cabinet with the controller, then the panel case must be connected to the cabinet by a ground strap. Do not plug the CP11 into a switched CPU outlet.

4.8 CC11 CONTROLLER INSTALLATION

4.8.1 SPC Slot Selection

The controller board may be placed in any hex SPC slot in the PDP-11 or an expansion box. The controller should be placed fairly close to the CPU so as to give it higher interrupt priority than other devices even though it does not need a high NPR priority. In all cases, Emulex disk controllers should be after the CC11 since they have a large amount of buffering.

4.8.2 NPG Signal Jumper

The NPG signal jumper between pins CA1 and CB1 on the backplane must be removed so that the NPG signal passes through the controller.

4.8.3 Controller Mounting

The controller board should be plugged into the Unibus backplane with components oriented in the same direction as the CPU and other modules. Always insert and remove the board with the computer power OFF to avoid possible damage to the circuitry. Be sure that the board is properly in the throat of the connector before attempting to seat the board by means of the extractor handles.

4.9 CABLING

4.9.1 Controller to Distribution Panel

A 34-conductor flat cable daisy-chains between the CC11 controller and the distribution panels. The cable plugs into J1 on the controller with pin 1 on the top (front) of the board. The pin 1 of the cable connector has a notch on the body to identify it. Also the pin 1 edge of the cable has a black stripe. In PDP-11/70 systems, the cable comes off the board and runs in the cable-way on top of the chassis and then through the strain-relief at the back of the chassis. On a PDP-11/34 system a right angle bend must be made in the cable so that it can pass over the top of the board.

The cable from the controller plugs into the top connector (J1) on the back of the distribution panel. If only one panel is to be used with the controller, the terminator plug is inserted into the bottom connector (J2). If more than one panel is to be used, a cable is plugged into J2 and connected to J1 of the next panel. The terminator card must be plugged into J2 of the last panel.

NOTE: The total cable length from the CC11 controller to the terminating distribution panel must not exceed 50 feet. Additionally, if more than one distribution panel is being used, the total cable length from the first distribution panel to the terminating distribution panel must not exceed six feet.

The panels are assigned addresses based on their order on the cable. The first panel will be the DH11 with the lowest Unibus address, the next panel will have the next higher Unibus address, etc.

4.9.2 Line Adapter to External Device (RS-232-C)

The CS11 communications multiplexer is used to provide communications between the host CPU and up to 64 external devices through individual ports. The external devices can be of various sorts, but they can be roughly grouped into two classes: local (no modem control signals required) and remote (modem control signals required).

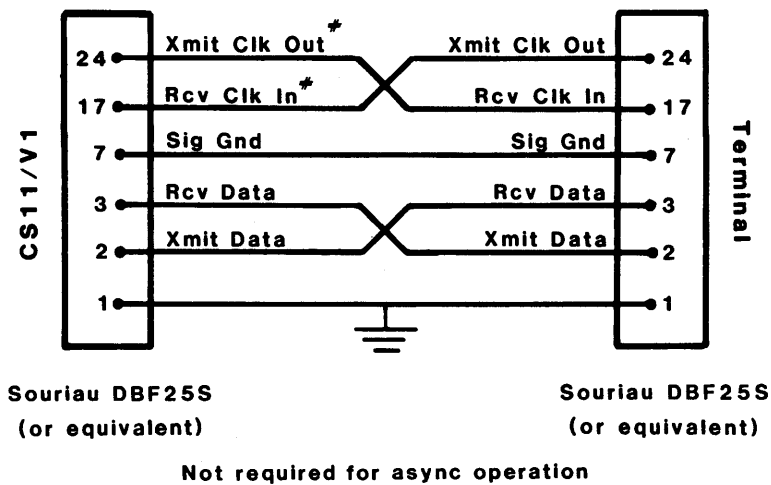


Figure 4-11
Terminal Cable Schematic

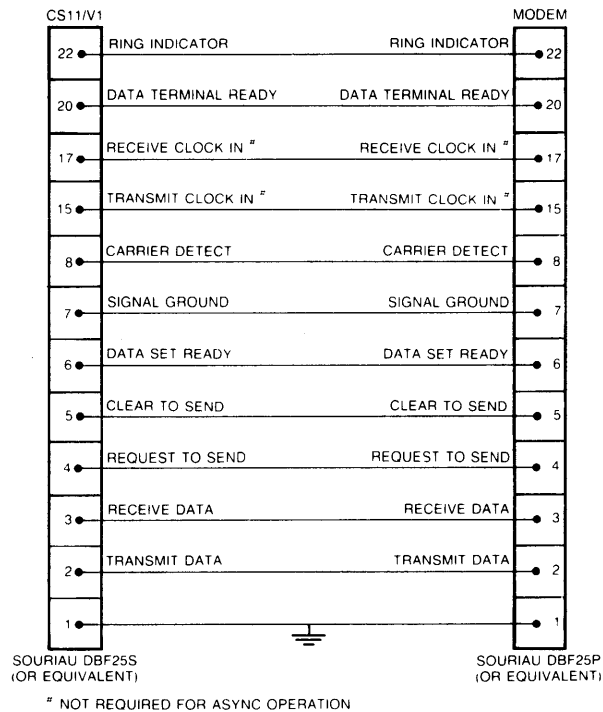


Figure 4-12
Modem Cable Schematic

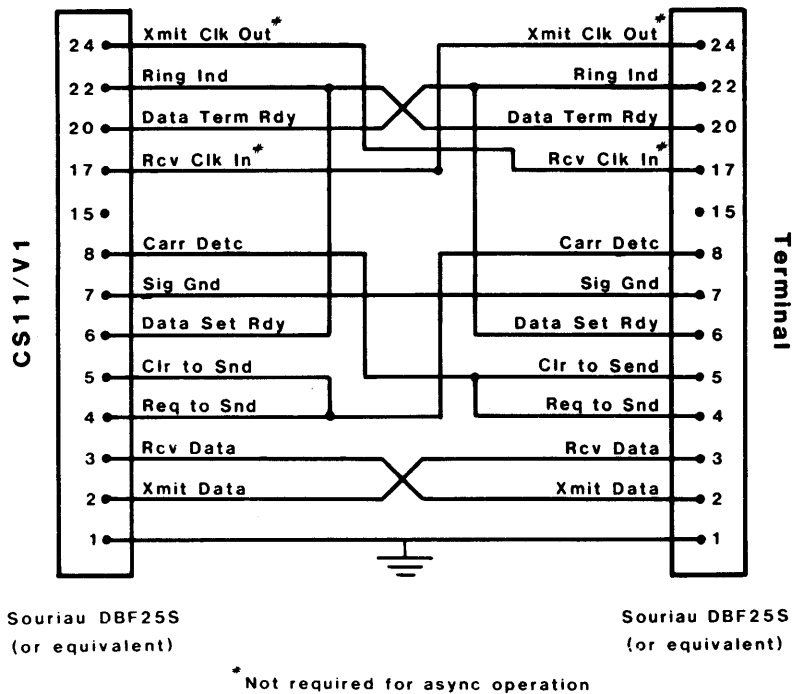


Figure 4-13
Null-Modem Cable Schematic

4.9.2.1 Cable Types

Devices that are in the local class (terminals, printers) can be connected to a port using a simple four wire-cable (six-wire for synchronous operation) called a terminal cable. A schematic of the standard DEC cable for local devices is shown in Figure 4-11.

Devices that are in the remote class (modems, other computers) require cables that can carry the modem control signals. Figure 4-12 is a schematic of a modem cable.

The CS11 hardware is unable to make the distinction between local and remote devices. The host operating system is told whether to use the remote or local mode for each line. If this is impractical because modems are constantly being moved from one line to another, then the remote mode is often specified for all of the communications ports. In such cases, the four-wire cable described for local devices will not work because the software will generate modem control signals and expect to receive the correct responses in return. Thus, devices that would normally be in the local class are connected to their ports using null-modem cables. These cables interconnect the modem control signals to give the software the illusion that it is talking to a modem. The standard DEC null-modem cable is shown schematically

in Figure 4-13. Note: With the CA11/V line adapter, pin 24 on the terminal plug may have to be connected to pin 15 if the terminal does not do this internally.

If any alternate pinning assignments are used the cables described above may not work.

4.9.2.2 Cable Lengths

The EIA RS-232-C interface standard to which the CS11 conforms guaranties error free transmission over cables of no longer than fifty feet. EMULEX DOES NOT WARRANTY OPERATION OVER CABLE LENGTHS GREATER THAN 50 FEET IN ANY CIRCUMSTANCES. However, satisfactory performance over cables of several thousand feet in length can be obtained depending on the speed of data transmission required and the environment in which the cable is placed. Emulex offers Table 4-12 as a guide for the practical application of the CS11.

NOTE: The ground potential difference between the DH11 and terminal must not exceed 2 V. This requirement will generally limit operation without modems to within a single building served by AC power service. In other cases, or in noisy electrical environments, 20 mA operation should be considered.

Table 4-12
RS-232-C Cable Lengths

Baud	Shielded ¹ (in feet)	Unshielded ² (in feet)
110	5000	3000
300	5000	3000
1200	3000	3000
2400	1000	500
4800	1000	250
9600	250	250

¹Cable is two, 22 AWG twisted pairs shielded in Belden 8777 (three pair). Shields tied to ground.

²Cable is 22 AWG 4-conductor (quad) inside station wire.

4.9.3 Line Adapter to External Device (20 mA Current Loop)

The CA11/C provides 20 mA current loop interface for use with older teletype-style equipment or in environments with a great deal of electrical noise.

4.9.3.1 Cable Type

The CA11/C comes configured with active transmitters and receivers. As such, each device with which the CA11/C interfaces must have a

passive transmitter and receiver. Determine whether or not individual devices have active or passive interfaces by consulting the manual for that device. If a device has an active transmitter and/or receiver, the CALL/C may be reconfigured for passive operation as described in paragraph 4.6.3.

NOTE: When passive operation is selected for a CALL/C channel, THE TERMINAL POLARITY IS REVERSED from that which is printed on the CALL/C's face.

When connecting a device to an adapter channel, these rules must be followed. Remember, if a channel receiver and/or transmitter has been reconfigured for passive operation, the polarity of the terminals will be reversed.

- 1) The T+ terminal of the CALL/C is connected to the R+ terminal of the slave device.
- 2) The T- terminal of the CALL/C is connected to the R- terminal of the slave device.
- 3) The R+ terminal of the CALL/C is connected to the T+ terminal of the slave device.
- 4) The R- terminal of the CALL/C is connected to the T- terminal of the slave device.

4.9.3.2 Cable Length

No definitive 20 mA current loop specification exists. The length of cable that may be used is a function of electrical noise, loop resistance, cable type and speed of operation. Table 4-13 is given as a practical guide to the cable lengths that can be used with the CS11/C adapter panel; however, there is no guarantee of error free operation under all circumstances.

Table 4-13
20 mA Current Loop Cable Lengths

Baud	Shielded ¹ (in feet)	Unshielded ² (in feet)
9600	500	1000
4800	1000	1800
2400	2000	3000
1200	4000	5000

¹Belden 8777, 22 AWG, shielded, twisted pairs (shield floating).
²22 AWG, 4 conductor inside station wire.

4.10 VERIFICATION

4.10.1 Self-Test

When power is applied to the CPU, the controller will automatically execute a built-in self-test. The test is not executed with every bus INIT but only on powering-up. If the self-test has been executed successfully, the Fault LED on the top edge of the board will be off. If the LED is ON, the controller did not pass its self-test and the controller cannot be addressed from the CPU.

In addition to the controller self-tests executed when powering-up, the electronics associated with each line on the distribution panel and each line adapter are tested. If any failures occur, the LED above the faulty line or lines will remain ON. If the override switch (SW3-4) is OFF and a fault is detected with one of the lines, the controller will hang. If the override switch is ON, the Fault light above the bad channel will still come ON, but the controller will not hang.

NOTE: If any distribution panel has only one line adapter (eight lines), then the controller will detect a line adapter fault. If such a configuration is used, the override switch must be on to prevent the controller from hanging.

The override switch has nothing to do with the controller's own self-test. That is, if the controller detects a fault in itself, it will hang regardless of the override switch's position.

4.10.2 Register Examination

After powering-up the CPU and noting that the FAULT indicator is not ON, a quick check should be made to insure that the controller registers can be read from the computer console. This can be done by depositing 177777 in location SCR + 10 (BCR) and then examining the location 177777.

4.10.3 Line Adapter Wrap-Around Test

The CCl1 controller is capable of running both internal and external wrap-around tests for each channel that is connected to it. For both the CALL/H and the CALL/C Line Adapters, the internal wrap-around tests are performed during the controller power-up self-test. If desired, both the internal and external wrap around tests may be initiated on a panel-by-panel basis by the slide switch located on each adapter panel. The internal test should be run during verification. The external test need only be run if a fault is suspected. The following paragraphs describe the procedure for all Line Adapters.

4.10.3.1 CALL/H, CALL/V, and CALL/A Tests

- 1) Internal Wrap-Around Test: The internal wrap-around test is run by simply placing the slide switch in the INT position for each panel that is to be tested. The controller will then select a loop-back data path, transmit a character, and then read the receive buffer to verify that the data has been received correctly. If an error is detected, the LED above the faulty channel will be illuminated. The controller will do this continuously, one character at a time. If the error is intermittent, the LED will flicker on and off. If a hard error occurs, the LED will remain illuminated after the slide switch is returned to the OFF position.

This test may be run without affecting the operation of any other adapter panel. That is, the system need not be taken down to run this test. If a fault is detected, the controller will not hang.

- 2) External Wrap-Around Test: The line receivers and drivers are not tested by the internal loopback test. If such a fault is suspected, the external wrap-around test will detect it.

There are two kinds of external tests, both executed with the slide switch in the EXT position. When the microcode detects the presence of a wrap-around connector, it will run the second of the two tests on that particular line.

The first test causes the line adapter to echo characters received from a terminal at 9600 baud back to that terminal. A fault within the terminal, the connecting cable or the Line Adapter will cause the character to be echoed incorrectly or not at all.

Once the identity of the faulty line has been determined, the second external test can be executed to further isolate the fault. Unplug the line from the adapter panel that is to be tested. The controller will then transmit a character out each line driver, and it will expect to see a character looped back through each line receivers. Because no loop back path has been provided, the fault LED will be illuminated. Plug the H315 wrap-around connector (see 4.10.6) that is provided with the CS11 into the channel. While the connector is in place, the LED above that channel should go out. If it does not, there is a problem with that channel.

If one of the channels has failed the external test yet passes the internal test, then the problem is either the line driver or receiver for that channel. This test may be

run without affecting the operation of any other adapter panel. That is, the system need not be taken down to run this test. If a fault is detected, the controller will not hang.

4.10.3.2 CALL/C Tests

- 1) Internal Wrap-Around Test: The internal wrap-around test is run by simply placing the slide switch in the INT position for each panel that is to be tested. The controller will then select a loop-back data path, transmit a character, and then read the receive buffer to verify that the data has been received correctly. If an error is detected, the LED above the faulty channel will be illuminated. The controller will do this continuously, one character at a time. If the error is intermittent, the LED will flicker on and off. If a hard error occurs, the LED will remain illuminated after the slide switch is returned to the OFF position.

This test may be run without affecting the operation of any other adapter panel. That is, the system need not be taken down to run this test. If a fault is detected, the controller will not hang.

- 2) External Wrap-Around Test: The line receivers and drivers are not tested by the internal loopback test. If such a fault is suspected, the external wrap-around test will detect it.

There are two kinds of external tests, both executed with the slide switch in the EXT position. When the microcode detects the presence of a loop-back data path, it will run the second of the two tests on that particular line.

The first test causes the line adapter to echo characters received from a terminal at 9600 baud back to that terminal. A fault within the terminal, the connecting cable or the Line Adapter will cause the character to be echoed incorrectly or not at all.

The second test uses a loop-back data path from the transmit to the receive terminals of a given channel to test that channels line drivers and receivers. However, to perform the test, either the line driver or receiver must be configured for passive operation while the other is configured for active operation. Reconfiguring a driver or receiver is somewhat involved. Consequently, it is recommended that the character echo test be performed a second time on a channel that is suspected of being faulty using a different terminal and line. If the channel still fails the character echo test with the new terminal and line, then the problem is probably in the Line Adapter. Although performance of the loop-back test is not always

convenient, the procedure is outlined below for those who care to use it.

Before running the external test, either the receiver or transmitter for each channel to be tested must be in the passive configuration. Follow the procedure in paragraph 4.6.3 to reconfigure one of the drivers. Also, the receiver filter must not be connected for external loop back testing.

After either the transmitters or receivers have been reconfigured for passive operation, the transmit and receive line for each channel must be connected together. Regardless of which half of the channel is active or passive, connect the two outermost terminals to one another and the two innermost terminals to one another. Do this for each channel to be tested. Place the slide switch in the EXT position. The controller will then continually transmit characters out the line drivers, and it will expect to see the characters looped back through the line receivers. All of the LEDs should remain unlit. If one does not, there is a problem with that channel.

After the test has been completed, return the channels to their original configurations. Place the slide switch in the INT position to reset the LEDs. If one of the channels has failed the external test yet passes the internal test, then the problem is either the line driver or receiver for that channel.

This test may be run without affecting the operation of any other adapter panel. That is, the system need not be taken down to run this test. If a fault is detected, the controller will not hang.

4.10.4 Mini-Test

If diagnostics are not available or it is decided not to run them, it is possible to prove out the NPR function which is not checked by the self-test, by running the following simple procedure from the CPU console:

- 1) Deposit 000400 into memory location 0; deposit 000377 into location 2.
- 2) Deposit 004000 into SCR location to clear controller.
- 3) Deposit 001000 into SCR location to set Maintenance Mode to achieve wrap-around. Could use different line number here.
- 4) Deposit 033503 into SCR + 4 location (LPR).
- 5) Deposit 000000 into SCR + 6 location (CAR).

- 6) Deposit 177775 into SCR + 10 location (BCR).
- 7) Deposit 000001 into SCR + 12 location (BAR) to enable line 0 transmitter.
- 8) Examine location SCR + 2 (RCR) four times and check the following:

100000 100001 100377 000377

- 9) Examine SCR and the following seven locations and check for the following:

101000 000377 033503 000003 000000 000000 000000 000000

The above procedure performs a transmission of three characters in wrap-around mode on line 0. Another line could be used. The silo is read out by examining RCR to see that the characters were transmitted and received properly.

This test can not be run on a PDP-11/34 and some older CPUs if the CPU is halted, since the NPR circuitry is not operative with the CPU halted. It will run if in console emulation mode.

4.10.5 Diagnostics

The ZDHM diagnostic should be run to insure that the controller and all the lines are operational. This program is a very comprehensive diagnostic and includes most of the functions of the other diagnostics. Instructions for running this program can be found in Appendix B. Patches for running this program with the Expanded Silo option can be found in Appendix C.

4.10.6 Test Connector

The diagnostics and the online "Line Test" activated by the Line Adapter Board slide switch require an H315 type wrap-around connector. One connector is supplied with each panel and a full set of 16 can be ordered from Emulex. The standard DEC H315 must have a jumper added from pin 4 to pin 6 if Data Set Ready is being used rather than Ring. The H315 connector has the following connections:

2 - 3	Tx Data - Rx Data
11 - 12	Sec. Tx Data - Sec. Rx Data
20 - 5 - 8	DTR - CTS - Carrier
4 - 22 - 6	RTS - Ring - DSR

BLANK

Appendix A

ZDHM DIAGNOSTIC

A.1 GENERAL DESCRIPTION

ZDHM is a comprehensive diagnostic test program designed to aid in the acceptance testing, installation checkout, and corrective maintenance of the DH11 16 line asynchronous serial line multiplexer. It consists of 48 logically sequenced diagnostic tests designed to test and verify that the DH11 is operating in accordance with its design specifications.

The program is configurable by the autosizer or by console dialogue to enable it to automatically test and verify all 16 lines on up to 16 contiguous DH11's (with non-contiguous/contiguous vector assignments). Individual units and individual lines within a unit may be selected or deselected to facilitate fault isolation to a particular DH11 or a functional area of logic affecting a particular line within a unit. Whenever an error is detected, a comprehensive error report is typed that allows the user to isolate the fault to a functional area of logic. Extensive documentation is provided to permit the user to proceed from the error report to additional logic checks in order to isolate the problem to a replaceable unit.

In order to facilitate installation checkout, tests 101 and 105 through 107 (test group 1) of the modem control diagnostic, ZDHK, have been included in this program. In this way, all the level converters and cables can be checked with just one program using the H315 turnaround connector.

NOTE 1: The H315 turnaround connector must be installed on any line under test when running ZDHM. As described in Section A.2.1, lines may be selected and tested on an individual basis.

NOTE 2: The ZDHM diagnostic will not consistently run error free if a distribution panel contains only one of the eight-line adapter panels. The procedure for testing an distribution panel with this configuration is to temporarily place another eight-line adapter panel in the panel. This problem is caused by the diagnostic's assumption that each DEC DH11 is equipped with 16 lines. The diagnostic expects certain modem status information from every line even though all of the lines might not be selected for testing.

A.2 DIAGNOSTIC PATCHES

The following patches must be installed before running the ZDHM diagnostic on the CS01/H2.

Patch Number	Location	From	To	Description
1	011700	012737	000137	Skip subtest 40
	011702	011730	012204	
2	012206	012737	000137	Skip subtest 41
	012210	012236	012512	
3	015306	012737	000137	Skip subtest 50
	015310	015362	015754	
4	017266	012737	000137	Skip subtest 54
	017270	017302	017526	
5	020102	005077	004737	Patch subtest 56: Add modem signal delay
	020104	010202	037720	
	020174	105227	005227	
6	020272	005077	004737	Patch subtest 57: Add modem signal delay
	020274	010012	037720	
	020364	105227	005227	
7	020462	005077	004737	Patch subtest 60: Add modem signal delay
	020464	007622	037720	
	020554	105227	005227	
8	020410	005077	000137	Skip subtest 60
	020412	007676	020576	
9	025322	170670	171370	Extend autosize address range
	026424	160420	161370	
10	037720	vacant	010546	Software delay for patches 5 and 6
	037722	vacant	013705	
	037724	vacant	030310	
	037726	vacant	005015	
	037730	vacant	005005	
	037732	vacant	005205	
	037734	vacant	001376	
	037736	vacant	012605	
037740	vacant	000207		

Patches 1 through 4 cause subtests 40, 41, 50, and 54 to be bypassed. These patches are required when running with the CP32 or CP34 distribution panels. These patches are not required when

running with CP11 or CP12 distribution panels. The CP32 and CP34 distribution panels use DUARTs which are not compatible in all cases with the operation of the ZDHM diagnostic.

Patches 5 through 7 insert software delays before Line Status Register reads in subtests 56, 57, and 60. These patches are required because the CS11/H2 updates the modem signal status every 5 milliseconds instead of every few microseconds as in the DM11.

Patch 8 causes subtest 60 too be bypassed. Subtest 60 attempts to test the Secondary Transmit and Secondary Receive signals on pins 11 and 12 of the 25-pin EIA connector. These signals are not supported on the CP32 or CP34 distribution panel.

Patch 9 extends the address range the diagnostic uses to autosize. The range is increased for the DH11 from <760020:760420> to <760020:761370> and for the DM11 from <770500:770670> to <770500:771370>. This patch is not necessary for the standard address PROMs provided with the CS11/H2 (see section 4.3.2.1 for Address PROM identification).

Patch 10 is software delay loop for patches 5, 6, and 7.

A.3 LOADING PROCEDURES

There are several different methods for loading the DH11 diagnostics under the control of the XXDP diagnostic monitor. The following procedure is common to many DEC systems and similar to others.

- 1) Mount the appropriate medium (Dectape, disk, etc.) containing the XXDP monitor and ZDHM.
- 2) Boot the system to load the monitor.
- 3) Once loaded the XXDP monitor prints an introductory message and displays a period (.) to indicate that it is ready to accept commands.
- 4) Type "L ZDHMD0." This will cause the diagnostic to be loaded, but it will not be started.

A.4 STARTING PROCEDURES

The console switch register is used to select between DH11 diagnostic program options. The program can also be started at different locations to allow it to be rerun without having to reenter the DH11 parameters.

A.4.1 Program Options

The CPU switch register (SR) is used to allow the user to select between several program options. The 16 bits of the register

represent different options during program start than they do during testing (SR = switch register).

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
SR	SR	SR	SR	SR	SR	SR	SR	SR	SR	SR	SR	SR	SR	SR	SR

Switch Reg.	Start	Testing
Bit 15 = 1	No function.	Halt on error (after typing message).
Bit 14 = 1	No function.	Loop continuously on current test.
Bit 13 = 1	No function.	Inhibit error typouts.
Bit 11 = 1	No function.	Inhibit sub-test iterations (quick pass).
Bit 10 = 1	No function.	Inhibit modem control on abbreviated test.
Bit 09 = 1	No function.	Lock on hard errors.
Bit 08 = 1	Halts after configuration to permit dumping pre-configured copies of the program.	Search for and lock on test selected by the contents of SR <07:00>.
<07:00>	See below for <01:00>	Contains test number to search for when SR 08 = 1.
Bit 01 = 1	Types device map generated by the auto-sizer.	
Bit 00 = 1	Allows the user to input DH parameters manually. (inhibits the autosizer).	

A.4.2 Normal Program Start At 200

After loading diagnostic, start execution at 200_h. Set SR bit 0 OFF if autosizer is to be used and set it ON if the operator is to enter the parameters. The operator should respond as indicated to the following questions asked by the program:

- Number of addresses between vectors - Enter 10_8 for standard DH11's with contiguous vectors; enter 20_8 if the DM11 vectors are interleaved with the DH11 vectors. The default value is 20_8 .
- Device address - Enter the octal address of the first DH11 in the system.
- Vector address - Enter the octal receiver vector address for the first DH11 in system.
- DH11 device selection - Type in a six digit octal number encoded as follows (setting bit 15 to one causes device 15 to be tested, setting bit 13 to one causes device 13 to be tested, setting bit 10 to zero causes device 10 to be ignored, etc.):

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
DH	DH	DH	DH	DH	DH	DH	DH	DH	DH	DH	DH	DH	DH	DH	DH

A value of 177777_8 will test all DH11s. The default is 177777_8 . (DH = Device)

- Line selection - Type in a six digit octal number encoded as follows (setting bit 15 to one causes line 15 of all selected devices to be tested, setting bit 13 to one causes line 13 of all selected devices to be tested, setting bit 10 to zero causes line 10 to be ignored, etc.):

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN

A value of 177777_8 will test all lines. The default is 177777_8 . (LN = Line)

A.4.3 Default Parameter Start At 204

When starting at 204_8 , the program will default to the parameters used in the previous execution. It should not be used for the first execution. The SR should be set for testing at the time the program is started.

A.4.4 Line and Device Parameter Change Start At 210

When the program is started at 210_g, it will ask the last two (parameter setting) questions of the input dialogue described above. Set the SR for testing.

A.4.5 Switchless CPU

If the diagnostic is run on a CPU without a Switch Register, then a software switch register (location 176) is used which allows the user the same switch options.

When SR values are needed the program types out the current value of the SR and asks for new values by typing NEW=. A control G will allow the user to change the contents of the software switch register.

Note: After typing control G, it may be necessary to wait up to 30 sec for the diagnostic to respond. This is because the diagnostic allows SR changes only after completion of each of the 48 subtests.

A.5 TEST SUMMARY

- 1 Check SSYN response from all DH11 registers.
- 2 Test that Master Clr can clear the SCR, LPR, BKR, SSR regs
- 3 Test SCR register R/W bits can set CLR (normal mode)
- 4 Test SCR register read-only bits (normal mode)
- 5 Test SCR register bits that can be Set/Clr in maint. mode
- 6 Test that all R/W bits in LPR can be set/clr
- 7 Test that all R/W bits in BKR can be set/clr
- 10 Test that all R/W bits in SSR can be set/clr
- 11 Test that Clr/Set bit N in LPR doesn't clear any other bits
- 12 Test that Clr/Set bit N in BKR doesn't clear any other bits
- 13 Test that Clr/Set bit N in SSR doesn't clear any other bits
- 14 CAR memory addressing test
- 15 BCR memory addressing test
- 16 CAR register test - all 1's / all 0's - all lines
- 17 BCR register test - all 1's / all 0's - all lines
- 20 CAR memory patterns test / 0's disturb
- 21 BCR memory patterns test / 0's disturb
- 22 CAR memory patterns test / 1's disturb
- 23 BCR memory patterns test / 1's disturb
- 24 Test that CAR memory ext bits Set/Clr properly
- 25 Test intr. enable bits - intr. condition disabled
- 26 Test char. available i.e., with intr. condition active
- 27 Test silo overflow i.e., with intr. condition active
- 30 Test NXM i.e., with intr. condition active
- 31 Test XMITTR done i.e., with intr. condition active
- 32 Transmitter NPR logic test 1
- 33 Transmitter NPR logic test 2
- 34 Test that character available can cause RCVR interrupt
- 35 Test that the silo status register counts up correctly
- 36 Test that silo status register down counts correctly
- 37 Test silo alarm level for counts 0,1,2,4,8,16, and 32
- 40 Transmitter timing test - all selected lines - all speeds
- 41 Receiver timing test - all selected lines - all speeds
- 42 Verify storage overflow-non maint mode-all selected lines
- 43 Basic data test - all selected lines/all character lengths
- 44 Single line data test - all selected lines
- 45 Basic parity logic test - all selected lines - odd parity
- 46 Multi-line parity data test - all selected lines
- 47 Auto-echo test 1 - all selected lines
- 50 Auto-echo test 2 - all selected lines
- 51 Auto-echo test 3 - all selected lines
- 52 Break bit test - all selected lines
- 53 Half-duplex test - all selected lines
- 54 Verify that overrun can set properly - all selected lines
- 55 Abbreviated modem control diagnostic (ZDHK T101)
- 56 Modem control diagnostic continued (ZDHK T105)
- 57 Modem control diagnostic continued (ZDHK T106)
- 60 Modem control diagnostic continued (ZDHK T107)

A.6 ERROR HEADER MNEMONIC DEFINITIONS

All numbers printed as error data are in octal

(PC)	Address of the error call (error PC)
(PS)	Contents of the PSW at the time of the error
(SP)	Contents of the stack pointer at the time of the error
TEST	Test number
DEVADR	Device address - 1st address in the selected DH11
REGADR	Address of the DH11 register being tested
WAS	What the actual data read was (DH11 register or memory location)
S/B	What the data read should have been
SPEED	Speed code in the LPR register at the time of error
TIMEB	Contents of software counter used in timing tests
TIMEC	contents of software counter used in timing tests.
CHRLNG	Character length code in the LPR at the time of the error 00=5 bits, 01=6 bits, 02=7 bits, 03=8 bits
TRPPC	Contents of the PC (R7) at the time of a bus error or RSVD instruction trap
TRPPS	Contents of the PSW at the time of a bus error or RSVD instruction trap
(LPRG)	Contents of the LPR register at the time of the error
LINACT	Flags used by multi-line tests to indicate active lines
WASADR	Memory address of the WAS data (actual data read)
SBADR	Memory address of the S/B data (good data)
SCRWAS	Contents of the SCR register
SCRS/B	What the contents of the SCR register should have been
LINCHK	Line no. being checked during CAR and BCR memory tests
LINEWR	Line no. being written into during CAR and BCR tests
PATTRN	Test pattern being written into CAR or BCR memories

Appendix B

EXPANDED SILO OPTION

A.1 GENERAL DESCRIPTION

As described in Section 2.4.1.3, each DH11 contains a 16-bit wide by 64 word deep silo. The amount of storage in this silo may be doubled to 128 words by closing the Expanded Silo option switch SW1-1 (see section 4.3). Using this option has the advantage of doubling the latency time available before a receiver interrupt must be serviced.

The ZDHM diagnostic test program may be run with the Expanded Silo option selected if the program is patched as described below. All subtests which use the Silo Maintenance function to fill the silo are skipped, since there is no Silo Maintenance function for the expanded silo. Other tests are modified as appropriate to handle the increased depth of the silo.

A.2 ZDHM DIAGNOSTIC PATCHES

<u>Location</u>	<u>From</u>	<u>To</u>	<u>Comment</u>
10734	12737	4	Skip Tests 34, 35, 36, 37
10736	10756	4	
10740	1110	4	
10742	13703	137	
10744	27304	11676	
12550	177677	177577	Patch Test 42
12754	77	177	
17322	177674	177574	Patch Test 54
17434	101	201	
17450	101	201	
27672	100077	77	Modify SSR Mask for Read/Write Bits

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Appendix C

ECS11 DIAGNOSTIC

UNIX users must apply the following patch to the ECS11 diagnostic for proper operation with the CS11/H2. Note that the patch modifies the diagnostic in memory, so it must be reapplied each time the diagnostic is run. This patch is for versions G and H of the Emulex diagnostic software releases only.

To apply the patch, load the diagnostic and apply the patch by typing "DEP E18 1A110101" at the diagnostic supervisor prompt. Below is a sample procedure for a VAX 11-750:

```
DS> LO ECS11
DS> DEP E18 1A110101
DS> ATT DW750 CMI DW0
DS> ATT DH DW0 DHA 760020 5
DS> ATT DM DW0 DMA 770500 4
DS> SET TR
DS> ST
```

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Appendix D

DECX11 SYSTEM EXERCISER DIAGNOSTIC

D.1 USING THE DECX11 SYSTEM EXERCISER DIAGNOSTIC

The CS11/H2 supports the DECX11 system exerciser diagnostic if two conditions are met:

- The CS11/H2 firmware is revision E or above.
- You are using a CP11 distribution panel with a CA11/H line adapter panel, a CP12 with a CA12/H line adapter panel, or a CP34 distribution panel.

Instructions for loading and running DECX11 are contained in the DECX11 user's manual. It will run normally with the CS11/H2, but two modifications must be made:

1. The DH11 module (DHAL0) must be modified. At the DECX11 prompt type:

```
MOD DHAL0 552<return>
```

When the system responds, enter:

```
1000<return>
```

This command sequence modifies the module for the first DH11 emulation. If you are running more than one emulation, repeat the sequence as needed for DHAL1, DHAL2, and DHAL3.

2. The DM11 module (DMBI0) must be modified if your DECX11 system includes the line time clock module (KWAG0). At the DECX11 prompt, type:

```
MOD DMBI0 36<return>
```

When the system responds, enter:

```
300<return>
```

If you are running more than one emulation, repeat the sequence as needed for DMBI1, DMBI2, and DMBI3.

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